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ABSTRACT

This fifth in a series of reports concerning school calendars examines the literature about learning, retention, and forgetting. The emphasis is necessarily on "time," as that is the major variable among calendars. Theories of memory are described: (1) storage and retrieval, and (2) imprint and trace decay. Relative to forgetting, a secondary concomitant is interference. The functioning of interference with retention and forgetting is explained. The report points up differences in the learning rates of advantaged and disadvantaged children. It also shows the summer losses that disadvantaged children have when the schools are closed for the summer. The appendix summarizes representative forgetting and retention studies. (Author/MLF)

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LEARNING, RETENTION AND FORGETTING

Technical Report No. 5

of

A Study of School Calendars
Conducted for the Board of Regents
of the State of New York

by

The Division of Research

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Carl E. Wedekind

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To conduct a literature search and compose a report about learning is by itself a major task. To include retention and forgetting made the total study imposing, indeed. George I. Thomas, consultant, conducted the literature search and wrote the preliminary report. His emphasis was necessarily upon "time," as that is the major variable among calendars. Subsequently, Dr. Lorne Woollatt and Jack Conway, consultants, edited the original document to its present form. Philip Pillsworth, William Alwell and Gerald H. Wohlferd, Project Operations Manager, reviewed the final copy.

Carl E. Wedekind, Director
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Chapter 1

LEARN TO REMEMBER

A Basic Problem: How to Improve Learning Through A Concerted Effort To Raise Retention Levels

"The Quality of Learning Can Only Be Measured by What Is Retained"

Massive amounts of energy - human and economic - are devoted to education in America. Great satisfaction attaches to the output of schools in terms of resultant invention, leadership and skilled labor. Conversely, great dissatisfaction attaches to failure to provide for millions the basic skills - academic, social, economic and civic.

Teachers are teaching fundamentals. Students are learning them in varying degrees. Most students are retaining a high degree of skill; some learn little, retain less. Obviously, the few who learn nothing in the first place, have nothing to retain i.e., remember.

Improving Retention

A major issue is the improvement of student output through raising levels of retention at three stages, namely,

1. During school year
2. Over summer
3. Over extended time

School Year Retention. The first stage is concerned with the distribution of review and reinforcement during the school year, generally from fall through spring. As teachers work with their students, they give periodic tests which show that a loss in retention occurs over a matter of days, weeks and months. In many classrooms the teachers teach and reteach, especially in arithmetic and spelling. The retention problem may not be as apparent in a content subject in which discrete facts can be studied in isolation and forgotten at the end of a month or two with no effect on subsequent learning. There is no real sequence so, if 70 percent of the earlier content has been forgotten, the students can attack the new unit and continue to learn. Two months later the students work with a new topic and again will go through a forgetting stage.

It is conceivable that the content teacher, e.g., social studies, will discover that the students have little recollection of the basic facts taught during the

earlier part of the year. The teacher may take time out to review and even reteach salient features of the course.

The final proof that forgetting is a major problem during the school year at the elementary, secondary and college levels can be seen just prior to the close of a term or school year. Teachers and students may spend several weeks reviewing the text or class notes in preparation for examinations. As a result, many students try to memorize the highlights of a course. They may be guided by a teacher who can be selective about what is retaught and the students may pass the examination without revealing how much they have forgotten.

Summer Retention. The second stage is concerned with retention after a summer hiatus. Numerous research studies indicate that long extended summer vacations result in forgetting much that was learned during the regular school year. Paralleling these studies are several which demonstrate that learning does not stop when the school doors are closed for ten or twelve weeks. Fall test results can be produced which prove that the students are reading or performing at higher learning levels at the end of summer vacation than they were prior to the start of the summer vacation (4,30).

The apparent contradiction regarding the impact of extended vacations has made it difficult to restructure the school calendar. Part of the resistance to change may be attributed to the significance placed upon the loss of learning.

In order to start a new year effectively, teachers in most elementary schools tend to devote four or more weeks on review and reteaching activities. Basic reading and arithmetic textbooks include page after page of review materials with the expectation that teachers will be reviewing and reteaching a large part of what was taught in the preceding grade. Such activities are evidence that forgetting does take place over the summer vacation (29,30).

In the earlier retention studies, reference was made to summer losses in reading and arithmetic by slow progressing students. It was often indicated that corrective measures could be taken in the home during the summer. For example, teachers would prepare worksheets for student summer use. Again, special summer school programs were instituted to meet the needs of slow learning students. Proof that children have a retention problem, can be found in more recent research studies. Test results of disadvantaged children show that these children are the ones who lose out academically over the summer. Any researcher who limits his study of summer losses to communitues which do not have a pocket of disadvantaged children will end up with a biased report.

A later section of this report will point up differences in the learning rates of advantaged and disadvantaged children. It will also show the extreme summer losses that these children have when the schools are closed for the summer.

Figure 1 is introduced to illustrate some of the differences that occur between black and white children on the basis of their family income. In this figure low achievement is shown as related to annual income. It also shows how the slope of the learning curve drops with the arrival at the summer test point. This is where forgetting begins and the loss of retention becomes a problem. In contrast, the learning curve for the better achievers and students from higher income families continues on an upward slant. These students generally do not have a major

retention problem with knowledge or skills which they can use in their daily lives. However, they will still encounter a retention problem with information that lacks meaning and cannot be applied to the solution of day to day problems, or in general is not subject to review.

Retention Over Extended Time. The third stage is concerned with retention over an extended period of time. It is relatively easy to demonstrate the seriousness of the lifetime retention problem. In a broad sense the criticisms levied against our schools should not be based on the conclusions that children have not been taught. As an illustration one may merely administer without warning a diagnostic type arithmetic test based on the average sixth grade arithmetic curriculum to the entire senior class of the average high school. The test results will generally demonstrate that the seniors cannot do as well as sixth graders taking the same examination. Six years earlier the members of the senior class individually and collectively could have mastered the same or a similar examination, but with time and lack of opportunity to practice and use skills they have forgotten much that had been learned.

This loss of knowledge over a span of years leads to the question, "How much of what is taught do we expect students to retain after five, ten or fifteen years?" If we believe that there has to be more permanency to learning introduced at lower grade levels, steps should be taken to provide time and expertise to insure that levels of retention are maintained. For example: freshmen who take typing for a year should be required to demonstrate that they have maintained their speed and accuracy as long as they are in high school. When they show a loss of retention, they should be required to return to the typing room until they show that they have regained much that has been lost.

In one high school special language arts tests revealed a dramatic loss in language skills. This was corrected by setting aside three 20 minute periods at the start of the day during which every teacher was required to teach prescribed types of language. In theory the crash program led to improved language arts test scores on the post test, but there was no follow-up to see whether each of the teachers required students to make use of the language skills in their daily classes throughout the regular school year or in subsequent years.

The foregoing examples merely demonstrate the fact that all schools have a responsibility to help preserve and/or increase learning beyond completion of courses. It isn't enough to institute an occasional crash program. The entire junior and senior high school programs need to provide reinforcement learning activities if earlier learning is to be preserved or maintained. This will be especially true where there is no sequence of learning from one year to the next.

The armed forces have demonstrated that military skills taught as a part of a basic training program will often be forgotten over a period of months and even years, but all is not lost. In refresher courses the trainees require only a fraction of the time originally required to teach designated standards. This same principle can be applied for the preservation of learning as a basic aspect of the third stage of the retention problem, but it will require a drastic change in the redistribution of time and schedules.

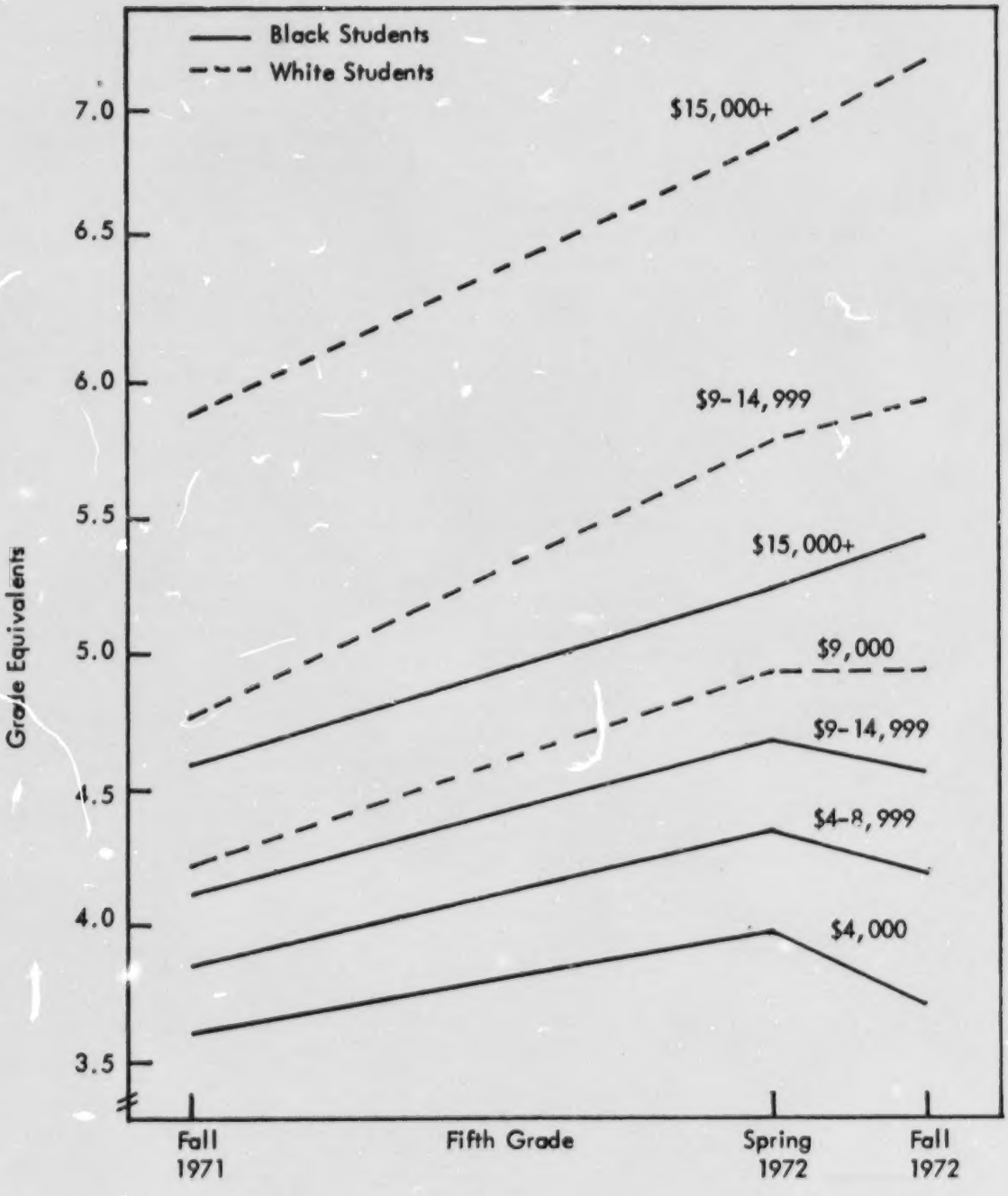

Figure 1. Rates of Cognitive Growth, by Race and Family Income for Sample of Sixth Grade Students (20).

Chapter 2

THE NATURE OF MEMORY

For over two thousand years man has been trying to understand the nature of memory. The early Greeks recognized man's uniqueness in his ability to learn and transmit learning to others. They knew that individuals were capable of learning and retaining much of what they had acquired in the way of knowledge and skills. They also knew that with the passage of time the individual would forget much if not all that has been acquired earlier. How and why this took place was a mystery which puzzled the leading thinkers of the day.

Plato tried to put learning into its proper perspective and after considerable conjecture conceived a mind which was waxlike in nature. According to his reasonsing the mind consisted of a waxlike slate which took impressions of what man said, thought or learned through his senses. Time was the enemy of man because with the passage of time the learning imprints or images began to fade from the waxlike surface of the mind. Ultimately, there came a day when there was no trace of what had been recorded some days, weeks, months, or even years before. Man's forgetting was attributed to the weakening of the images recorded earlier.

Plato's explanation of the nature of learning and forgetting was something the Greeks could readily understand since wax tablets had been used for writing. The phenomenon could be illustrated by simply writing on one of the wax tablets and then exposing it to the sun. In a very short time the image would disappear. Today the ancient theory still has credence in the present day Imprint-Trace Decay theory.

Plato did not attempt to locate the seat of knowledge so other Greeks conjectured as to the location of the mind; among them was Aristotle. He hypothesized that such an important gift from the Greek gods would be located in the most important part of man, namely the heart. As a result Aristotle assigned all the functions of the brain and memory as a function of the heart. The concept seemed logical to the Greeks so it wasn't long before the heart was considered as the source of all knowledge or learning. It may explain the expression, "It was learned by heart."

Arisotle had a grandson named Erasistratus who made one of the first dissections of the brain. He was fascinated by his brain studies . He rejected his grandfather's placement of memory in the heart and broached the theory that the brain was the center of a complex nervous system. Apparently Erasistratus built a good case for his theory because the Greeks accepted it.

The Greeks had a number of very special gods who could work for them or against them. Among them was Zeus. As the story goes, Zeus' wife, Mnemosyn, who was the mother of the nine daughters called the Muses or the patron saints of the various arts, felt very good one day. She thought it was time to give the Greeks a very special gift and so she did. It was in Mnemosyn's honor that her gift was called MEMORY.

Little new knowledge came to light until Ebbinghaus introduced what we consider today as the beginning behavioral studies of memory in 1885. Prior to this time a group of individuals known as the British Associationists had many armchair discussions about the association of ideas. They speculated about learning for some two to three hundred years, but little was actually done to test or prove their ideas.

A Century of Progress

Ebbinghaus was interested in the problem of retention in memory so he conducted experiments in an attempt to measure the rate of forgetting, essentially the opposite of retention. His work was followed by a series of experiments by researchers in several countries. A door had been opened and has yet to be closed. In the intervening decades thousands of articles have been written about learning, retention, forgetting and other topics related to memory. A computer search identified 1900 articles which specifically had the word memory in the title. The approach proved to be only a beginning because numerous writers included new sources or other bibliographic references that had not been identified in the computer search.

During the 1900's several theories about the nature of learning were advanced, but it is difficult to prove them since researchers have yet to discover the true nature of memory. In the late 1950's rapid, short-term forgetting in a matter of seconds was established, causing psychologists to think that memory was more complex than had been expected. At about this same time research established that human sensory systems had short-term forgetting characteristics. Starting in the 1960's the input of research on memory vastly increased and new theorizing about memory accompanied it. (1)

Update: The Discovery of Microcircuits in the Nervous System. For several decades the physiological basis of behavior has been dominated by the concept that man's nervous system is composed of centers and pathways. Within the centers groups of neurons, or nerve cells, subserve specific functions such as the processing of sensory information and the control of movement. Some of these nerve cells give rise to single, long, thin fibers called axons. They transmit information from one center to another in the form of electrochemical impulses. Behavior, therefore, involves the continual transmission of impulses in the axons of different pathways.

For some time neurophysiologists could not tell what controlled the axons. However, recent research has shown that centers are connected by tiny microcircuits. In 1974 Gordon M. Shepherd wrote (35):

"Nerve circuits are usually analyzed in terms of the axon, the long fiber of the nerve cell. It now appears that there are many circuits involving only the nerve cell's shorter extension, the dendrites."

The dendrites are short branching strands emanating from the nerve cells of a specialized region of the central nervous system. Some of the dendrites branch sparingly while others branch profusely. Some may extend for less than a millimeter while other dendrites may extend for several millimeters.

For many years it was believed that the neuron received signals through the dendrites and cell body and then the transmission was done through the axon. In the 1950's the electronic microscope revealed the existence of synapses or junctions that connect nerve cells. Information is transferred from one neuron to another through the synapses by means of chemical messengers known as neurotransmitters.

Shepherd cites the importance of a discovery in 1965 of synapses between the dendrites of mitral cells and granule cells. The discovery of dendrodendritic synapses contradicted the early conclusions that the nerve cell could only receive signals with its dendrites and cell body and transmit them through its axon. Other research workers have been frustrated by the fact that dendrodendritic circuits exist. They found it difficult to accept the possibility of independent circuits since they suggest that neurons can communicate with each other through their dendrite circuits without the intervention of an axon or nerve impulse. Shepherd sums it up with the following:

"The available evidence indicates that dendrodendritic synapses are similar in basic respects to the synapses made by axons. It is now apparent that they are a logical and economic way to organize synaptic interaction in the minimum space. The reciprocal synapse between dendrites is the most compact synaptic circuit yet identified in the nervous sytem. We can therefore consider it to be a microcircuit, at the opposite extreme from the microcircuits between nerve centers made through long axonal pathways."

Neuroanatomists have had to change their mode of thought and action in the face of new evidence. As a result they have identified a long list of synaptic circuits through dendrites. It now can be said that circuits have been found in the major parts of the nervous system. These circuits integrate information and transfer it to the brain.

In an attempt to explain the concept of the permanency of learning theory some researchers have tried to compare the working of the nervous system with a computer. However, questions have been raised about brain capacity of exceeding a billion units such as one finds in our largest computer. However, the discovery of the new microcircuits opens up the possibility of a nervous sytem which has a permanent retention capacity of several trillion units.

Theories of Memory

Three theories of how memory operates exist, namely, retrieval, trace decay and interference. Interference is really a theory of forgetting and will be discussed at the end of this chapter.

Storage and Retrieval. The retrieval theory sounds reasonable and logical for many people. Simply stated, the retrieval theory is based on an assumption that everything learned goes into permanent memory storage. There is no such thing as trace decay or interference. The learning is there and will remain in storage until the right cue is given. Then the information or skill comes forth. The recall

depends upon the use of a variety of retrieval approaches. The theory is currently paralleled by computer applications.

At times retrieval from long-term memory storage appears without any outward recall stimulus. Out of nowhere one recalls a scene out of the past. Why? What was the recall cue? When was it given? Was it something he saw or heard that started a memory? There have been some good experimental studies on retrieval. They all depend upon some type of stimulus to bring forth something that appears to have been forgotten. Psychologists refer to this approach as prompting. Their reminder stimulus has been labeled, "The Prompter." An illustration can be seen in television games which depend upon someone's ability to remember a name or a song based on receipt of a cue or clue. With practice, some individuals can be quite adept in retrieving information. Retrieval for most individuals will depend on the nature and quality of the learning originally placed in his long-term memory storage bank.

Imprint and Trace Decay.

Imprinting is the oldest theory of memory. Plato would recognize it as an outgrowth of his thinking. At the moment, one can find considerable support for both retrieval and imprint theories. Trace Decay remains within the realm of probability. Some individuals see the combination of all these theories as being operative since there are unanswered questions about learning and memory.

Chronological time alone is considered responsible for the loss of memory. Forgetting is the end product of what is referred to as trace decay. Recent studies of the brevity of sensory memory would appear to support those who contend that the brain does not put into storage every "bit or chunk" of the various types of stimuli that enter the nervous system. Unfortunately, there is no supportive evidence that the passage of empty time results in the fadeout of the sensory memory stimuli.

The theory of trace decay is postulated on the thesis that time is the factor that accounts for the spontaneous deterioration of the learned material. We forget because there is nothing left. Retention is zero. Some theorists believe that trace decay is associated with short-term memory. One has to assume that there has to be some level of learning or there is no forgetting.

Sensory Memory

All memory storage systems have to begin with a source of input. For many years the emphasis was placed on verbal retention which was nothing more than visual memory. Now, psychologists are going beyond this single sensory memory and for the first time are exploring in depth the characteristics of a memory for each sense. The length of the various sensory memories is much briefer than what has been referred to as short-term memory. Auditory memory appears to be more closely related to short-term memory than any of the other forms of sensory memory.

Visual Memory (Iconic memory). Visual trace may not last more than a second. However, experiments with the Tachistoscope and refined measures have made it

possible to set new maximum time limits for visual memory at about two seconds. Still to be resolved is the issue of whether the forgetting in visual memory is due to the trace decay associated with time or to the intrusion of events in time that interfere with retention.

Information from visual images is obtained from a process referred to as readout or scanning. The visual trace may be translated into a verbal code or to a nonverbal image. Essentially, readout calls for a contact with well-learned elements stored in long-term memory. Readout is very rapid. Sperling used a Tachistoscope and found that letters could be read out at a rate of 10 to 15 milliseconds per letter or 65 to 100 letters per second.

Auditory memory (Echoic memory). The retention period for auditory imput memory is much longer than it is for visual memory. It may range from 2 to 10 seconds. Auditory memory is generally associated with the processing of speech, but some visual processing goes on. When someone speaks, the words may be processed one at a time or we may store segments of incoming sounds in auditory memory and then process them into words or sentences. They may be integrated and temporarily stored as chunks in short-term memory and then ultimately in long-term memory.

Research studies have shown that an auditory mode of presentation leads to higher retention levels than visual presentations. This will be especially true if the element of vocalization is added. For instance, saying material aloud during learning increases retention. (The best recall comes with vocalization. The next best with whispering and the poorest comes with silent study.)

Motor memory. Motor memory lasts about 80 seconds. It is strongly affected by practice. The number of errors decrease with practice but increase with time after practice ceases. The longer the retention interval, the more prevalent are the errors. The assumption has been made that Motor Memory and Auditory Memory may be combined to influence short-term memory. For example, when one vocalizes something that is being heard, use is made of multiple sensory traces since the vocalization requires motor trace.

Tactile memory (Touch memory). Tactile memory is very short, perhaps no more than about four seconds.

Olfactory memory (Smell memory). Studies of olfactory memory are relatively new. However, such memory has a persistence that exceeds all of the other sensory memories. Engen, Kuisma and Eimas (14) used 100 different odors in their tests and found no evidence of forgetting. One study found little, if any, forgetting for 30 days.

Span of Memory

The time of memory storage is generally conceived of as short or long. Obviously some memory is intermediate but the concept is clearer if emphasis is placed on short and long. Researchers call this "forced sort." After one masters the short-long concept, time span may be looked upon as a more continuous, dynamic phenomenon.

Short Term - The Working Memory. In the course of living we learn many things which are of little consequence, or which, once used, are no longer needed. It doesn't make sense to assign them to a place in the brain where they will be stored indefinitely. It has been convenient to think of a memory system which consists of two separate storehouses, one concerned solely with short-term memory and the other with long-term memory. Other researchers will accept the concept of a long- and a short-term memory, but will not accept the concept that the brain separates them or assigns them to different parts of the brain.

The short-term memory is a temporary storehouse, but it is not to be confused with sensory memory which for the most part has a retention life of but a few seconds. The short-term memory system has a limited capacity which is often referred to as one's memory span. This is the number of items that can be immediately recalled without error.

There is considerable evidence that the short-term memory system may be a refinement of the auditory sensory system. However, the knowledge of the latter is so recent that it is impossible to actually prove the relationship. Preliminary evidence supports the notion that there is a primary acoustical structure for short-term memory. It is based on the concept that encoded letters or words transmitted from the long term store (indirectly from the sensory store) seem to have characteristics corresponding to the sound of the letter or word even when the modality of the original stimulus is visual (8).

At one time memory span was associated with age, sex, intelligence and academic achievement. Today, memory span is no longer thought to be related to these early variables. It is now considered as the capacity of short-term memory. For a time, capacity was measured in terms of bits or pieces of knowledge. Each individual's short-term memory bank's capacity was limited to seven bits of information. Hence, telephone numbers are often given in seven digits. It has been assumed that the average person can read a number out of the telephone book and repeat it back correctly in less than 30 seconds.

There have been many experiments of memory span built around the use of seven digits, but other experiments used letters, nonsense syllables, words, sentences and pictures. This led to the encoding of digits, thus 1520100 may be considered as "Fifteen," "Twenty" and a "Hundred." If we consider each of the words as the equivalent of a unit, "fifteen" which contains seven letters now fills one of the spaces in the memory bank and the word "twenty" fills another space until, with the addition of "hundred," only three spaces in the short-term inventory bank are filled, leaving four free. Under the original interpretation of capacity, the individual who has substituted words for digits will have exceeded his short term memory.

In 1956 Miller (26) proposed that capacity be measured in terms of functional units called "chunks," with a chunk being equal to the largest linguistic element of the stimulus input that is familiar to the subject. He demonstrated with substantial evidence that his definition was realistic for setting the magic number at seven plus or minus two. Regardless of the kind of information, the limit extends for adults from five to nine chunks. The acceptance of "chunks" in lieu of "bits" helps to explain why individuals appeared to be exceeding what was accepted as the capacity of short-term memory. Today, there is less emphasis on the significance of seven. It is no longer recognized as a constant. In 1969 Crowder (12) said that

"memory span is not so much a restriction on what humans can store, but is instead a limit on what they can or are willing to learn in the first place."

One of the characteristics of short-term memory has been its limited capacity for processing information. The rapidity of memory loss, referred to as "decay" and the restoration rate referred to as "rehearsal" has come under criticism, and so psychologists are looking for a new answer to short-term memory.

Long-Term Memory. The brain appears to be constantly active as stimuli, which originate in various sensory organs, make their way through the body. Under the stimulus-response philosophy the afferent neurons bring impulses to the central nervous system including the brain. It has been estimated that the brain contains at least ten billion nerve cells which are activated from time to time by electrochemical impulses.

One theory says that the brain contains a network of circuits which carry the learning impulses to a series of clusters, one of which may be responsible for short-term memory while others will respond to impulses calling for long-term memory. This theory sometimes sees the brain as a segmented storehouse where short-term and long-term memory never come together. In contrast there are individuals who refuse to compartmentalize the brain. They prefer a single storehouse which contains both short- and long-term memory capabilities. The differences in the recall responses are based upon the nature of the prompting cue. For example an electro-impulse may call for immediate memory or a short-term awareness of information or motor skill. In contrast, a chemical impulse theoretically activates the long-term memory cells. The theory seems reasonable since the body contains and produces a variety of chemicals. Again, a direct injection of some chemicals may appear to stimulate the mind whereas the injection of another chemical will act as a mind depressant. Unfortunately, the research on the nature of short-term and long-term memory is still inadequate for us to do much more than speculate about the localization of hypothetical memory storehouses and how learning is retrieved.

Long-Term Memory for Education. Short-term memory is referred to as a "working memory." This is where information is held while it is processed or rehearsed. What often passes for learning may never go beyond the short memory stage. As such it appears to have faded away or been forgotten.

Good teaching can increase retention and lead to permanency of learning, but several variables can block learning. The goal of the teacher is to help process the learning in such a manner that information or skills can be transferred from short-term memory to long-term memory. For many teachers the answer lies in repetition, but for others the answer lies in coding. The teacher has to help a student organize ideas, concepts and facts. At the same time the teacher broadens the child's background and helps him or her use old knowledge and learn new knowledge.

Early studies of retention have demonstrated that memorization of facts will not stand the test of time. Facts alone tend to have a short life, whereas concepts and understandings, if properly learned, appear to be retained over extended periods of time.

In the early studies of shortterm memory, mention was made of a memory span of seven bits. Originally this was considered as seven digits, but when the

concept of chunking was introduced, encoding became increasingly important. The chunks could contain words, phrases and even sentences. In theory long-term memory has become the storehouse for chunks of knowledge or information. When recall is necessary, the memory search is facilitated by a search for organized chunks of knowledge instead of for isolated bits.

The disadvantaged child may be at odds with his teachers because his limited background makes it difficult to formulate the coding system needed to process ideas and knowledge so they can more readily be transmitted from short-term to long-term memory. Again, the organization of material is essential to understanding. If the child has learned to code his or her knowledge, it will likely be more meaningful. Studies have repeatedly shown that retention levels are much higher when the understanding level is high.

The assumption has been made that the reorganization or reconstruction of knowledge is a function of the brain. In actuality the changeover from short-term to long-term memory is the result of external stimuli. What one thinks and how one thinks depends upon the totality of the individual's experiences both in and out of school. Reinforced learning will be retained longer than knowledge that has not been reinforced. If one wants to speculate, it is possible to visualize reinforcement as the buildup of a concentration of electrochemical impulses until there is a cluster of long-term memory cells ready to be activated by a recall command.

The inference of the foregoing implies that related learning is stored together. This theory is in conflict with one which states that there is no actual clustering. The mind stores information about related items independently. There is also the case for free recall learning from long-term memory storages. Which theory is correct is still a matter of conjecture. The resolution of this conflict will depend upon further research regarding the nature of long-term memory.

A summary of the length of time each type of memory typically lasts appears as Table 1.

Table 1

Memory Time Limits

Type	Maximum Length of Retention
1. Sensory Memory	
(a) Visual Memory	2 Seconds
(b) Auditory Memory	10 Seconds
(c) Motor Memory	80 Seconds
(d) Tactile	4 Seconds
(e) Olfactory	Indefinite
2. Short-Term Memory	30 Seconds
3. Long-Term Memory	Indefinite

Learning

Learning theory is complex. Only the result of learning is pertinent to this report. However, certain aspects of learning strongly underly retention and forgetting.

Degree of Learning. Retention depends to a large extent upon the degree of learning. The higher the level of mastery, the less the amount of knowledge forgotten, and consequently the greater the retention. This will hold true even when the comparison is between nonsense and meaningful material. It may take longer to learn the nonsense material, but if the same levels of learning are reached the rate of forgetting will be the same.

There are a number of side effects associated with the degree of learning. For example, the student whose mastery level is low will not acquire the understanding necessary for retention. Facts, in themselves, will not be preserved over long periods of time, whereas concepts or understandings which are associated with high degrees of learning may be retained indefinitely. Perhaps the big issue is one's definition of mastery. The student may believe that he or she has learned the 20 words in the weekly spelling list when it can be spelled without error, but this may be nothing more than a memory exercise. If one does not understand the meaning of the words, he or she is not going to use them in oral or written language. Mere memorization without understanding should be considered as a low degree of learning. The thoroughness of the original learning is a key to high level retention.

Mental Set. The degree of learning will depend upon the learner's attitude towards or interest in the activity. If the learners see no value in the learning activity, they may force themselves to go through the motions of learning with the result that their retention will be of short duration. Very little behavior change results when individuals are merely told to do something. Retention tends to be much higher when the learner is told why he or she should perform an act or learn a body of knowledge. Similarly, the retention will be greater if, after a test, the learner is provided some information regarding the activity and how well he or she performed. A future set for new learning may be created by the teacher when he or she shows the students the nature of their errors or successes.

A negative set for learning may exist, as long as students see the learning as something inside a book. They need to get involved personally in the act of learning. Discussion and involvement become important. Until students begin to relate to events, places and things, their degree of learning will remain at a low level. Here the set for learning may be related to the nature of the tools with which they have to work. For example, pictures and color will often attract children to a reading corner. Then the teacher may have to set the stage for learning by telling or reading the children a story which is of interest to them. It will help establish the students' set for learning if they can see themselves in the story. It should appeal to both the person and his or her imagination.

Subsequent Activities. The nature of the activities that precede or follow a learning activity will have a bearing upon how much is forgotten and retained. Studies show that immediately after the act of learning the progress of forgetting

is rapid - a good reason for recommending review activities at the end of the class period. Again, in the case of the student learning French and German in subsequent periods, retention of the French component will be facilitated by a review prior to taking the German class.

Efficiency of retention is improved by practices in learning and recall. If one is learning something for the first time, concentrated practice will help in the preservation of the next learning. However, after having a familiarity or understanding of the material, retention will be greater with a distribution of practice and review.

A clustering of facts around a concept or general principle will reduce the level of forgetting and lead to an increased level of retention more than will the learning of isolated facts, details, or rules. Here again the nature of the intervening activities between the initial learning and the recall is important. If one has strengthened old learning prior to retrieval, the strengthened response should dominate over the newer learning which may still be in a state of reorganization in the memory system. However, if the new learning has been reinforced by practice and association with other examples of meaningful material, learning acquired earlier will remain in storage unless appropriate cues are used to bring it back to the strength required for a response.

Continuity. Most school subjects are not thoroughly learned or mastered in one school year. In fact, the learning is spread out over extended time periods. Therefore, the teacher has to plan to build continuity into class schedules. It is essential that learning be recognized as the acquisition of many types of knowledge learned at the same time. One of the dangers learners face is that there may be gaps in their learning unless steps are taken to insure that there has been a continuity in the motor-learning experiences to which they have been exposed.

Research has shown that one can forget a number of sub-skills or bits of knowledge once the concept has been learned. This will often appear in a math class. Many students will develop shortcuts or eliminate steps in order to obtain a correct answer. While the teacher may find it disconcerting, the pupil who has a good math sense sees continuity of higher learning levels rather than a continuity of sub-learning skills. Unfortunately, the term continuity can be misconstrued since different students arrive at various learning levels at different stages of their development. Experiential level or background can enhance learning or lead to frustration and forgetting.

Degree of Similarity. The more alike items or materials are the harder it is to learn them. For example, learning a list of words including the following: mammoth, huge, large, icy, cold, immense, frigid, giant and arctic may pose problems for the learner because the words have too much in common for easy memory storage. It helps if the learner can visualize either the word or an association word. However, when two or more words lead to the formation of the same visual image, confusion sets in.

In an attempt to avoid the problem of similarity, students may be taught to look for differences and similarities as a part of the learning process. Teachers direct students to learn new material through association or the use of clue words. For example, in learning a long list of numbers, the student may be taught to use a chunking technique or clustering to give meaning to the number. The clustering of

numbers in groups of 3 will facilitate remembering a number consisting of 15 digits. It is a method of organizing information to facilitate retention.

Levels of Processing

Originally the short-term memory span was thought to be limited to a time block that ranged from 0 to 30 seconds between the time it left sensory memory and was transferred to long-term memory. The latest theory proposes that the time span exceeds 30 seconds if one accepts rehearsal, encoding and the formation of language mediators and images.

In 1972 Craik and Lickhart (10) proposed an alternative model to what had earlier been based on a computer analogy. They introduced what has been referred to as levels of processing with the understanding that the greater the depth of processing, the less the forgetting. Thus, they start with sensory learning as a lower level of processing. Here the issue may be nothing more than recognizing the sensory and physical features of the stimulus. A deeper level might be recognition of the stimulus and at a still deeper level the information may be processed for meaning and understanding.

In addition the new theory refers to a central free floating processor which could be diverted to any processing level. Items in the central processing unit are considered to be conscious and are receiving attention. As such, they are referred to as being in a state of short-term memory. Forgetting does not begin until items are diverted from the central processing unit.

Levels of processing are not new to the field of psychology, for example, intentional learning and incidental learning may be considered as different processing levels. Here intentional learning is considered as a deeper level of processing than incidental learning.

Reminiscence

Reminiscence is an improvement in performance instead of a decrement in learning following a passage of time in which there has been no practice. Usually, an increase in learning occurs within a few minutes, though in some cases it may not appear for two or three days. A pupil may correctly spell seven out of ten words. Apparently, he or she has reached mastery level. How does one explain the ability to spell all ten words on a later recall test without any intervening practice or review. The explanation may lie in delayed recall.

Interference

Time is recognized as the major ingredient that leads to a loss of memory. The issue is not chronological time, but what happens in time. Experiments

conducted to prove the Trace Decay theory of memory loss repeatedly failed because it has been virtually impossible to work with absolute empty time. Something always seems to get in the way - the basis of the interference theory. Interference is of two kinds, namely:

(a) Events which take place between the learning of material and the test for retention or recall

(b) Events which took place before the learning of the material and its recall.

The two types of interference are considered responsible for what appears to be a decay of stored material. However, some theorists refer to the loss of memory as something more than decay or disintegration. They lean towards a reconstruction process, a reorganization which goes on between learning and recall. So far there is considerable evidence in favor of interference. Interestingly enough, there have been several experiments which have demonstrated that retention is higher when sleep is introduced as a variable between learning and recall. Here, the assumption had been made that there is less interference during periods of sleep than when the persons are awake. Interference is considered as an active theory of forgetting. Without interference there is no forgetting.

Chapter 3

THE RETENTION OF LEARNING

Of major concern to educators and parents is the kind of learning, the amount of forgetting and the levels of retention reached by children during the regular school year. In the United States the nine to ten month calendar begins in late August or during the first two weeks of September. It comes to a close at the end of May or in June. During this period students are legally exposed to instruction for 170 days or more, but in some states the minimum number may be as high as 180. If one includes an allowance for snow days and other special emergency days the maximum may extend to more than 185 days.

Interruptions in Learning

The continuity of learning is broken by holidays, special days of observance, conference days, emergency school closings and vacations such as Christmas, winter, spring or Easter. Since the legal interruptions in learning are short, educators have not asked questions about their impact on learning, forgetting and retention. Asked about the amount of forgetting that occurs over a two-week winter vacation, teachers tend to reply, "We may take a day or two to get back to where we left off, but the children need the review anyhow." Thus, teachers apparently have accepted these interruptions in learning. A literature search failed to reveal any studies which showed the extent of a learning loss that could be attributed to the interruptions in learning due to legally approved absences ranging from one day to two weeks during the course of the regular school year (September through June).

Student Absenteeism. Parents are often told that excessive pupil absenteeism will result in low report card marks and even failure. Here the issue may be (a) one of an administrative concern over the loss of State aid due to low pupil attendance averages, or (b) teacher concern because the student who has been absent for several days will be out of step with his peers in basic skill subjects. A teacher may find it necessary to provide review activities, or even reteach the skills taught during a student's absence due to the interruption of learning.

As for the student, the amount of time required to make up assignments will depend upon the nature of the individual and his background. High student achievers can be out of class for several weeks and not require extra attention because they are so far ahead of the average student that the class never catches up with them. An average learner may require some assistance from the teacher or a friend for a few days in order to catch up with his peers. On the other hand a low achiever may fall so far behind that the loss of instruction over a one- to two-week period may be injurious to his or her continued progress. The teacher may feel obligated to give special makeup assignments, but these do little to overcome a deficiency which may already be two or more years below the standard for the grade.

In an individualized program where teachers take children where they find them, one finds a different setting for learning. The issue of trying to "keep up" or "catch up" makes pupil absenteeism a minor problem in terms of teacher preparation and directions.

Soar (36) studied pupil absenteeism in a Follow Through report and stated, "In summary, there was no clear evidence that fewer days absent is related to gain, which seem surprising." In a parallel report on observations of thirty-five experimental Follow Through programs Stallings (37) wrote that:

(a) Absenteeism is lower in "open classrooms" or in classrooms where there is a high rate of child independence, child questioning, adult responding, individualized instruction and open ended questioning

(b) Children are absent less where children and adults smile and laugh more often

(c) Children were absent more frequently in both first and third grade classrooms where they worked in large groups and where adults used direct questions in academic work and frequent critical corrective feedback

(d) Findings for the third grade indicate that, in classrooms where children were punished, absenteeism was higher

(e) Classrooms with a higher rate of negative, harsh, or demeaning statements on the part of teachers and students showed a higher absence rate

(f) A report of absence rates indicates that at the first grade level, children in classrooms of sponsors who used more highly structured environments, materials, and interactions also had a higher absence rate.

Support for the forgoing statements are found in the Needels and Stallings report (28). A study of the mean days of absences showed that three models in 15 project cities used a wide variety of activities and materials associated with low pupil rates of absence. Similarly, two models, the University of Kansas and the University at Oregon, which had been described as having the greatest amount of structure, had high rates of absence. The rates of absence decreased as children moved to upper grades. This may have been due to the prevalency of early childhood disease rather than a change in the variables.

On the assumption that the schools which showed the greatest number of days of absence would be least productive, the lay person would be inclined to predict better student achievement with the schools showing the lowest absentee rates. However, the schools which operated under the models calling for a structured program or the ones which had the highest rates of absences showed greater gains in first grade reading than all other sponsors and greater gains that the control classes. Similar results were found for math. In the University of Kansas model first graders excelled above all others in math whereas the University of Oregon model had higher third grade scores in math than all the others. These two models had the largest amount of student absenteeism, but they also showed the best gains

in reading and math. The findings suggest that classroom procedures contribute to child achievement in reading and math more than days in school.

Pupil Mobility. Estimates of the extent of the mobility of the American public ranges from 20 to 25 percent. In 1964, the U. S. Census figures showed 35 million people changed residences. Of this number, 6.8 million changed county or state. Over seventeen percent of all children between the ages of 6 and 17 fell in this category. In 1968-69, an estimated 2.7 million children entered a public elementary school during the school year, either for the first time or after having been enrolled in another school. Nearly 2.5 million children reportedly left an elementary school during the same year.

In some states and cities, one encounters more student mobility than in others. A case in point is Arizona. The 1970 Census reported 53 percent of the population changed residences either within the state or out of state. Similarly, it is common in certain big-city schools to have a population turnover of over 100 percent by Thanksgiving. A school with a fall enrollment of 1200 students may have 1200 or so enrollees in the spring, but for the most part they are not the same individuals who were there in the fall. With such rapid turnover, it becomes difficult to obtain valid or reliable evidence of the impact of special projects or activities unless the progress of individuals can be followed from school to school. This has been especially true when attempts have been made to evaluate the effectiveness of Title I projects.

In the studies of pupil mobility, some researchers see little difference in the achievement of mobile and non-mobile children who merely change schools within the district or within the city as a whole. As a result, some of the research has been limited to mobility between states and counties.

Parents often reflect teacher views that a change of schools within a school year will result in a loss of attendance and therefore a drop in marks. It has been theorized that mobile children will have to make so many adjustments when they move from one school that attitudes, interest in school, and achievement will change. Surprisingly enough, many studies do not support this teacher and parent concern about achievement.

Concern over the mobility factor has resulted in a large number of research studies dealing with highly disadvantaged children, middle socioeconomic children, and children of military families who often move to other countries as well as to other states. The general conclusion is that continuous attendance is not a necessity for maintaining desired levels of achievement. Several studies report that mobile students did make good adjustments to their new schools and communities; in some cases they obtain a higher social status in the new school than children who have not moved. Suipes said (38):

"Moving pupils achieved better success in reading vocabulary and reading comprehension. Pupils who had experience in various schools and who had lived in other states and countries tend to be favored in reading achievement over non-movers. The number of moves pupils made did not appear to have a detrimental effect on reading achievement; rather, moving strengthened reading achievement."

One study of children of Air Force personnel showed that mobile children achieved higher marks and tested higher than nonmobile students. Here, there was

a slight hint that ability may have accounted for the superiority of the mobile Air Force children. However, other studies reported that there was no significant difference in their achievement when I.Q.'s were held constant. Three studies involving inner city, low income, Title I, disadvantaged children reported no difference in reading between mobile and non-mobile students.

Two studies of intermediate grade mobile students reported that some weaknesses appeared in the test results of boys in selected subjects such as math, reading, social studies and writing. However, no weakness was mentioned in some twenty other studies. One study of the impact of elementary and junior high school mobility on high school marks reported no relationship between low marks and mobility. Another secondary school study indicated that the mobile children were less apt to take part in social activities such as clubs, sports, and special school organizations. This finding is an apparent contradiction to the study that reported mobile children in the elementary school were apt to be more popular. None of the studies reported on the emotional adjustments adolescents faced when they left old friends behind, but this could be a factor related to the size of a school and the location of the student's home in relation to the school.

Gurecki (17) studied the relationship of the length of continuous attendance in a particular school to reading and arithmetic achievement test scores. She reported some differences. None were statistically significant enough to conclude that length of continuous attendance affected sixth grade achievement scores.

The number of students in attendance at any given point during the school year may range from the 95 percent average in the suburbs to 70-75 percent in the larger cities. In selected inner city schools no more than 50 percent of the children will be in school on any given day. As a result, generalizations about the effect of attendance on achievement must be considered in terms of the characteristics of each school and the background of the children.

In considering the relationship of mobile children to achievement, the studies may be meaningless for disadvantaged children. Those who have moved from school to school may have lost fewer days of school than the nonmobile children.

Chapter 4

RETENTION AND FORGETTING

In Chapter 2, two theories of memory were described, (1) storage and retrieval and (2) imprint and trace decay. Relative to forgetting, a secondary concomitant is pertinent, namely (3) interference. Accepting a composite in place of the three makes understanding of the nature of forgetting and retention easier.

Retrieval

It is often said that everything we learn, be it good or bad, remains within us the rest of our lives. In essence, this theory of reasoning is the foundation of the "Retrieval Forgetting Theory." For acceptance one virtually is required to give serious consideration to some form of trace decay in sensory memory and short-term memory. However, the interference theory may need to be recognized, especially if future studies can verify that interference leads to unlearning as well as learning.

Retrieval is associated with things that have been learned. If exposure to knowledge has not led to learning, nothing has been placed in memory storage. Hence, it cannot be retrieved. Learning does not really begin until the knowledge passes into long-term memory. Then, if the knowledge is used, a search-and-find signal travels almost instantaneously through the nervous system and the individual makes a rapid response. If the knowledge has not been used, the search and find operation may require extra time. In some instances the desired response may not come forth so one says, "I forgot." In reality, the knowledge has not been lost. It is still stored in the individual's memory bank. This is when prompting or cueing the learner helps. The material or knowledge is still locked up in memory storage, waiting and ready to be released, if and when the right retrieval signal is presented.

Trace Decay

The concept of trace decay derives from the idea that learning is imprinted in the nervous system. Information used repeatedly, deepens the imprint. Conversely, information not used fades and disappears. Short-term memory results from mere scratches on tissue; long-term from deeper or repeated imprints.

Interference

A strong and persistent explanation of forgetting is interference from other interests and activities which demand attention. Usually, the most recent is the

most demanding. As the span of activities and interests expands, earlier ones tend to fade, sometimes virtually to disappear. In a sense, interference intertwines with retrieval and trace decay. Leakage develops in the retrieval system and imprints decay. However, reactivation of earlier interests and activities revives them more readily than if they were brand new ones.

Retroactive inhibition. There are two aspects of interference. One is retroactive inhibition, which means that new learning will interfere with the retention of and the recall of earlier learning. It refutes the early belief that forgetting is due solely to the passage of chronological time. It has substituted events in time as the causal factors. The forgetting of knowledge or skills learned or acquired some time in the past is due to the dominance of something learned between the original acquisition of knowledge and the initiation of a recall strategy. This does not mean that everything learned today will block out old learning, since levels of responses may vary in strength. Several possible responses may be on the threshold of recall. This is why different tests of retention elicit different responses. Sometimes new learning reinforces earlier learning, but then it may make the early learning obsolete or meaningless. Just how this occurs is not answered by the forgetting theory, but if one can accept a reorganization of old knowledge in terms of the acquisition of new knowledge, the permanent value of schooling becomes significant.

References to retroactive inhibition date back to studies completed in Germany in 1900 by Muller and Pilzecker. Their findings were recognized almost immediately as having significance by all who were interested in understanding the nature of learning, retention and forgetting. This led to many studies of forgetting based on laboratory experiments which supported or challenged the retroactive inhibition theory of forgetting.

In the laboratory, researchers have been able to demonstrate how forgetting of prior learning can be modified through the introduction of new learning, but the issue of what occurs in the brain still remains a matter of conjecture. If a student attempts to study two languages such as French and German in two successive class periods, a conflict arises. During the first class period the student studies French, then he changes classes and studies German in the second class period. Later he tries to recall some aspect of the learning acquired in the French class only to find that some of the knowledge acquired in the German class is interfering with what he learned earlier. Part of this interference may be eliminated by a rescheduling that calls for a study of the two languages on different days or after an intervening class period or periods during the day.

Proactive inhibition. Another aspect of interference is proactive inhibition, which means that current learning will interfere with the acquisition of new knowledge sometime in the future. Most of our forgetting can be attributed to proactive inhibition. Something learned yesterday, a week ago or several months ago gets in the way of new learning today. For example, we have learned a number of telephone numbers in the past. Now when we are given a new telephone number to remember, the memory of the old number which we have used repeatedly blocks the learning of the new number. This conflict can only be resolved through repetition, practice and use of the new number until it becomes more dominant than the old number.

Ebbinghaus Curve of Forgetting

Modern studies of the permanency of learning have their origin in the experiments conducted in 1885 by Ebbinghaus. He wanted to know how much information or knowledge would be forgotten in a designated period of time. Ebbinghaus learned lists of nonsense syllables and then tested the amounts of retention after various lengths of time following the initial learning. For example a test at the end of 19 minutes showed that he had forgotten 41.8 percent of the initial learning. At the end of an hour his retention was just under the 50 percent level. By the end of the day he had forgotten 70 to 75 percent of his original learning. From this point on the decline in the amount of forgetting was very, very low from one day to the next. He still retained 21 percent of the initial learning at the end of 31 days. Ebbinghaus plotted the amounts of learning that had been forgotten in the first 24 hours following the initial learning and over the 31 days. This gave him what has since been referred to as a forgetting curve.

In 1903-04 Radossawljevitch refined the Ebbinghaus forgetting curve with 29 subjects. He reported a somewhat slower forgetting rate, but the general shape of the curve conformed to the one made about two decades earlier.

In 1912 Fin Kenbinder modified the study of forgetting by using an anticipated method in the presentation of nonsense syllables in series of twelve. He found that the rate of forgetting was a bit slower than had been reported by Ebbinghaus, but a bit faster than had been reported by Radossawljevitch (24). He used eleven time intervals for his learning curve and his numerical curve developed a simple equation:

Forgetting = 10 (log of time in number of min. + 1)

With the passage of time, numerous experiments were conducted with somewhat different results. A complex formula for anticipating the rate of forgetting was developed.

It is possible to construct formulas for a learning curve in a laboratory or experimental situation, but the variables in real life can modify the rate of forgetting or the degree of retention. In general writers agree that:

(a) Forgetting is more rapid at first

(b) The amount of retention will vary in degree with the passage of time

(c) The ultimate curve of forgetting is generally uniform

(d) Forgetting curves tend to approximate each other with some variations depending on chance deviations

(e) Forgetting curves tend to approximate each other, but may have different or variable parameters according to different conditions.

Variations in Rate of Forgetting

Later researchers tried for many years to fix the rate of forgetting, but with the introduction of different variables they obtained different rates of forgetting. A sampling of their findings is presented in Table 2.

Table 2

Variations in the Amount of Forgetting That May Take Place in the First 24 Hours After Learning

Name of Researcher	Percent of Loss in First 24 Hours
Ebbinghaus	65%
Yentz	88%
Luh	82%
Krueger	74%
Hovland	78%
Cheng	65%
Cheng	84%

If one averages the rates of forgetting presented in Table 2, one obtains a forgetting loss of approximately 75 percent in the first twenty-four hours after the initial instructions. It is attributed to the interference of prior learning.

A 75 percent forgetting loss in 24 hours became an accepted forgetting rate in research circles for a good number of years. However, new research using refined techniques and with different materials led to a rejection of the early standard forgetting rate of 75 percent.

The breakthrough is attributed to work done by Underwood and his associates in 1957 (44, 45). See Figure 2. Underwood estimated that individuals will forget about 25 percent of their initial learning and will retain about 75 percent of it at the end of 24 hours. Here the reduction in the rate of forgetting was attributed to the use of numerous variables such as meaningfulness, similarity, degree of

mastery, etc. Later Underwood revised his 25 percent forgetting loss to 15 percent due to the possibility that measurement errors entered the picture (46). Subsequently other researchers insisted that it is possible to reduce the forgetting loss in 24 hours to zero with the introduction of new variables during the act of learning.

The 25 percent loss was attributed to interference of new and ongoing learning. One must remember that many individuals may be forgetting at the 75 percent figure if and when the variables that affect retention of learning are ignored. This was noted by Underwood when he summarized his findings thus:

> "The overall evidence suggests that similarity with other material and situation similarity are by far the most critical factors in forgetting."

Variables affecting rate of forgetting. Individuals often ask "How long will I retain what I have learned?" They want a formula and may accuse the respondent of avoiding the issue if he says, "The rate of forgetting depends upon a number of variables such as the following:

(a) Meaningfulness of the material

(b) The method of measuring retention (retrieval technique)

(c) The level of mastery of the initial material

(d) The ability of the learner

(e) The purpose of the learner

(f) The age of the learner

(g) The method of presentation

(h) The length of time between presentation and measurement

(i) Learner's experiential background

(j) Familiarity with the initial material

(k) Degree of difficulty of the material

(l) Frequency of practice or reinforcement

(m) Quantity of material presented for initial learning

(n) The amount of time given for learning

(o) Experiences of new learning introduced between initial learning and measurement

(p) Psychological factors motivating forgetting

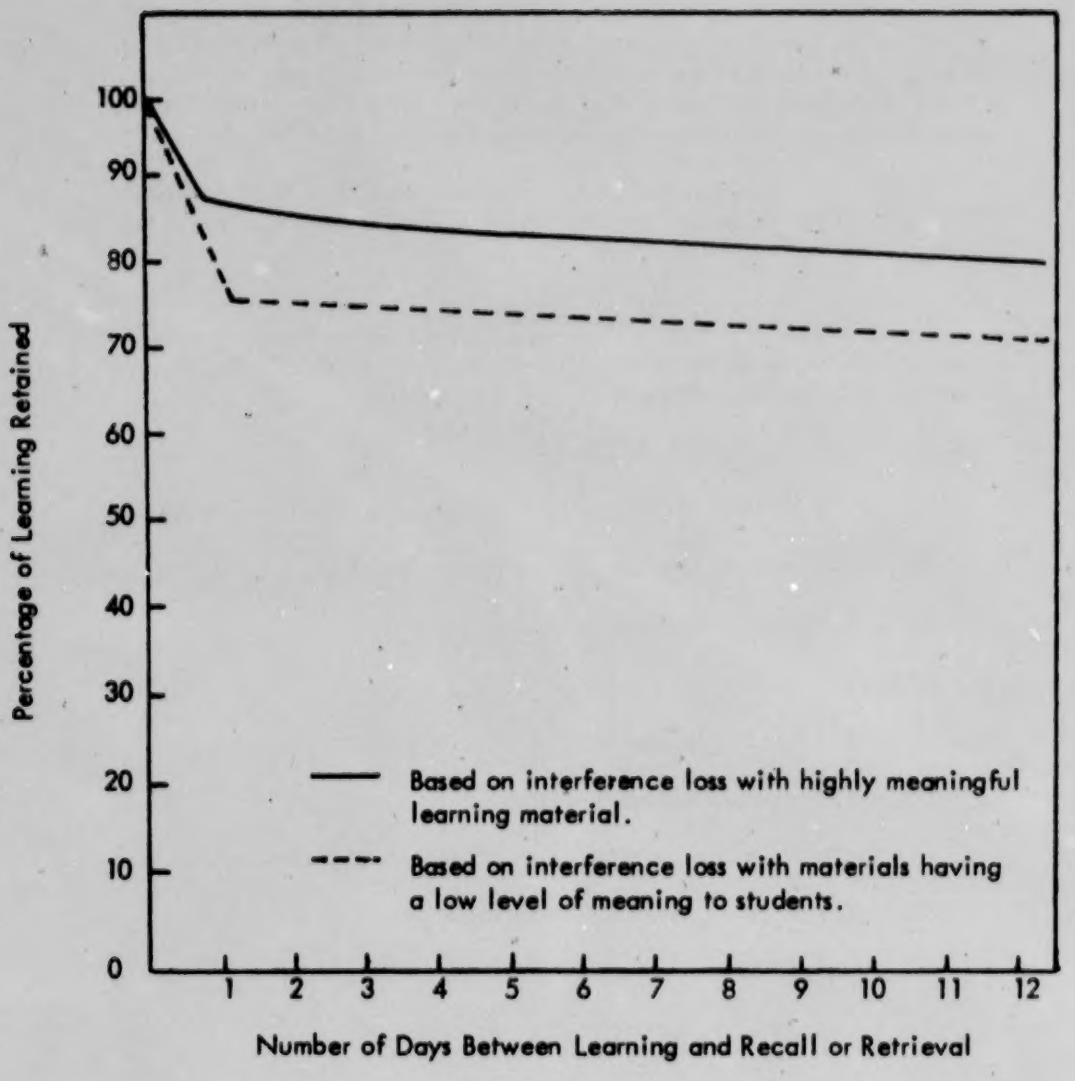

Figure 2. Rates of Forgetting. (Based on Experimentation after 1957)

(q) Physical health at the time of learning or retrieval

(r) The mind set of the learner

(s) Socioeconomic background of the learner

(t) Racial background

(u) Material similarity

(v) The teacher's professional training

(w) The teacher's teaching experience."

Research shows that different students learn at different rates of speed and in different amounts. The differences are related to the amount of knowledge retained and forgotten with the passage of time. Some of the variables may be beyond a teacher's control and some are of a nature that the teacher may have corrected. For example, learning may not have occurred at the very start of a learning activity because:

1. Some students were not listening
2. Some students may have only heard a fraction of what was said and were unprepared for what followed
3. Some students had no interest in the topic
4. Some students failed to see any purpose in the lesson
5. Some students could not understand the words used
6. Some students had been distracted by outside noises or by what other students were doing
7. Some students lacked the experiential background necessary for understanding.

If the students had only learned 30 percent of what the teacher had tried to teach, a loss of 25 percent of their learning would have left the students with a low state of readiness for a lesson calling for the learning of higher level concepts or new learning. If the teacher is to be successful, she has to be prepared to reteach and review until certain that the students have reached desired or acceptable mastery levels.

The Passage of Time

Many educational issues could be readily resolved if high forgetting rates or curves could be attributed to one factor, namely the mere passage of chronological time. For example, the trace decay theory has been given as one of the laws of forgetting. Unfortunately, it does not hold up when put to the test of time,

because all of us find ourselves remembering things years after an event occurred. In theory this should not happen. Once the original stimulus was presented it should have sent messages to the brain or memory cells where they should have eroded with the passage of time. Is memory to be considered as a temporary or permanent conditioning? Perhaps, it would help if trace decay could be linked to empty time, a period in which nothing happened, a period in which there is no learning. Three aspects of time involvement are important in retaining knowledge.

Review. Permanence of learning depends upon a number of variables, one of which is review. In a broad sense, review activities may be considered in terms of three periods during a school year. In school subjects which have a measure of continuity over more than one school year, the average classroom teacher does not begin to introduce new learning with the start of the new year until time has been taken for review and reteaching. Generally, the goal is to bring the level of retention in the fall to what it was prior to the start of the summer vacation.

Following the completion of the fall review period the teacher proceeds to introduce new units involving new skills and knowledge. Now the teacher may find that the new materials will suffice to maintain skills and knowledge taught earlier. However, he or she may find that forgetting of both the old and new learning continues. He or she finds it is necessary to constantly plan review activities from week to week or from month to month as long as there is a continuity to the instruction. The review necessary for retention can be built into the day-by-day lessons without it becoming apparent that the teacher is constantly coping with a retention problem.

If, however, the course consists of a number of nonsequential units, the academic loss for a unit taught in November and not reviewed between November and February could exceed the loss which occurs over the summer. If the earlier learning was important, the teacher might find it desirable to provide special review activities to rebuild to an earlier retention level. Unfortunately, periodic review activities are seldom provided with the result that regular school learning activities or new learning stops in the late spring.

At some grade levels, especially at the high school level, teachers and students are expected to enter a crash program of reviewing and relearning in order to pass final exams. In many classes the level of forgetting is so great that it may take several weeks to regain early mastery levels or in some instances to reach learning levels not reached when the knowledge or skills were first taught. As a rule, memorization of facts looms high for many individuals. In this case the student takes an examination and seeing no further need for what was learned, makes no further attempt to preserve his or her learning. The result is often a rapid loss of skill or knowledge.

Summer vacation. Learning goes on for all children during the summer. Interference factors lead to forgetting of much that has been learned earlier under the sponsorship of the school. The strength of the new summer learning stimulus becomes increasingly significant. The longer the vacation, the more interference factors enter the picture, the greater the educational loss. However, students who acquire knowledge through summer experiences that relate to, or have some common elements with their earlier school learning, can return to school in the fall without having forgotten their prior learning. The interference factors have had enough common elements to reinforce earlier learning without guidance, prompting or direct assistance.

Other students may not open a book, read a newspaper, magazine or other piece of written material. They had no need for arithmetic and did not engage activities that called for intellectual discourse or use of language on levels comparable to those encountered in the formal classroom. They played endlessly and spent considerable time with peermates who saw very little value in school-sponsored activities. They may have taken time out for television which did not include educational programs. They were not in school, but were learning. The problem centers around the nature of their experiences. They failed to reinforce earlier learning. When they returned to school no measures were taken to evaluate what they had learned over the summer. Thus. formal or informal tests aimed at measuring educational gains or losses showed that they have lost 20 or 30 percent of the prior year's learning.

In essence, the rate of forgetting differs for the two groups of students because of the intervention of events in time which reinforced or failed to reinforce memory bonds established earlier.

Sleep. The human brain actively receives messages from many sources every waking hour of the day. As a result, the individual is virtually in a continuous learning state while awake. Over the years, several studies of retention have been made to measure the effect of sleep on retention. It would appear that our sleeping hours represent a period when forgetting appears to be minimal (See Figure 3). Just why is not exactly known, except that the assumption had been made that the hours of sleep come close to what may be considered as empty time, a period in which there is little opportunity for the interference factor to obstruct the learning process. The studies of retention have been accepted in psychological circle as evidence that retention remains higher during the hours of sleep than when the individual is awake.

From an educational standpoint, students may find that a period of study before going to sleep, plus a quick or brief review on awakening will lead to greater retention than study during the day.

Along different lines, experiments have been conducted to test the belief that learning levels can be raised through playing records or tapes while the individual is asleep. So far, the evidence fails to demonstrate that the mind is ready and willing to receive and codify new learning stimuli once the individual has truly gone to sleep.

Retention of Concepts

Individuals vary in their ability to learn concepts. In many instances failure to learn concepts is due to lack of maturation and experience. Some investigators contend that the motivation factor is linked with chronological age. However, wide variations exist in the ability of individuals to formulate concepts and to transfer them to meaningful situations.

Meaningful material is forgotten far more slowly than relatively meaningless material. Mursell (27) cites a study by English (a contemporary experimenter) in which the subjects studied difficult but meaningful prose. They went through the

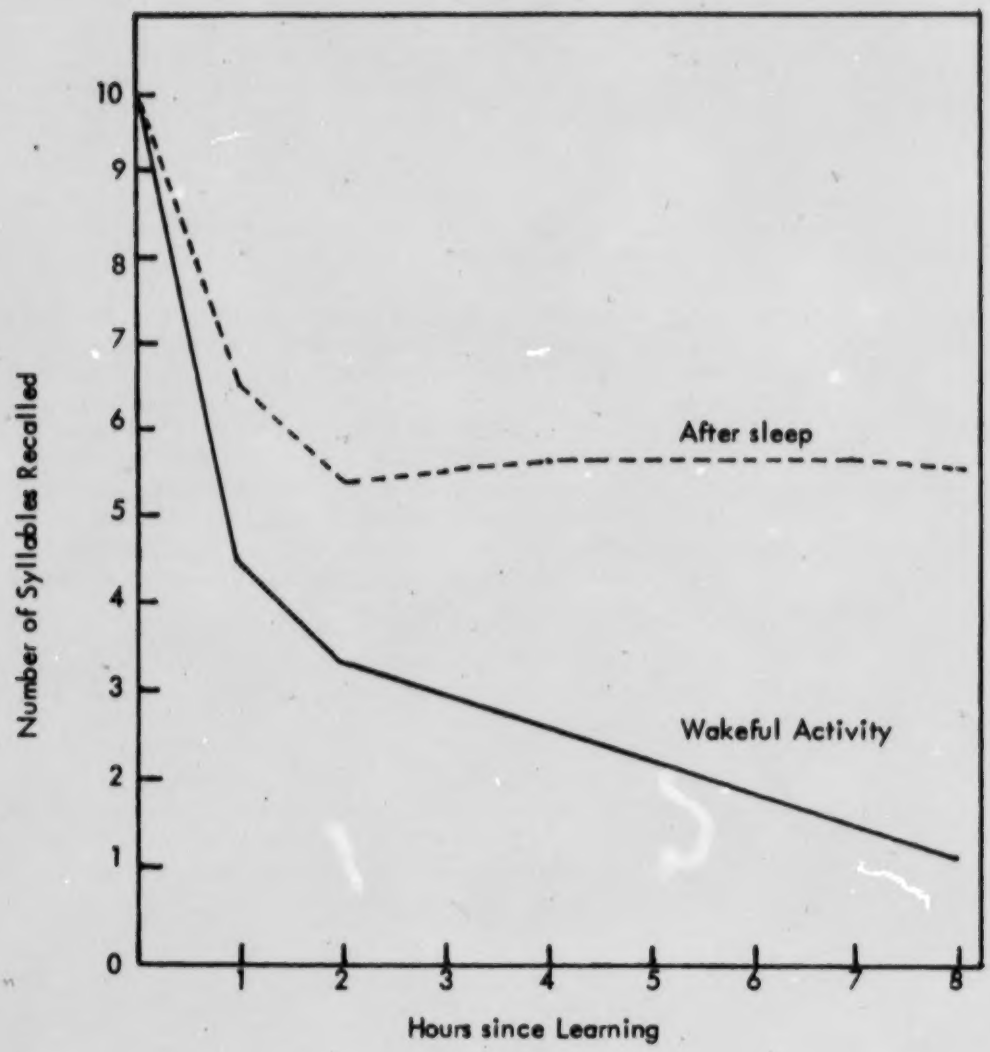

Figure 3. Retention of Nonsense Material After Sleeping Compared with Retention After Equal Periods of Wakeful Activity (21).

passages four times before taking a true-false test. The study showed that memory for exact wording declined rapidly. But memory for content that had been understood did not decline at all for 70 days.

Similarly, Gilliland (16) had subjects observe sets of pictures. Then three sets of eleven questions were given at different intervals. After 48 hours one group could mention 85 percent of the items they had noticed. At the end of thirty days they had retained about 75 percent of what had been observed. Another variable was introduced when the subjects were asked to respond to the question in terms of a measure of confidence based on how sure they were right. The curve dropped rapidly and indicated a potential loss of 50 percent by the end of five days and a loss of 70 percent by the end of 25 days. In a study of poetry Gilliland showed a potential loss of slightly more than 20 percent in five days and a 50 percent loss at the end of 30 days (See Figure 4).

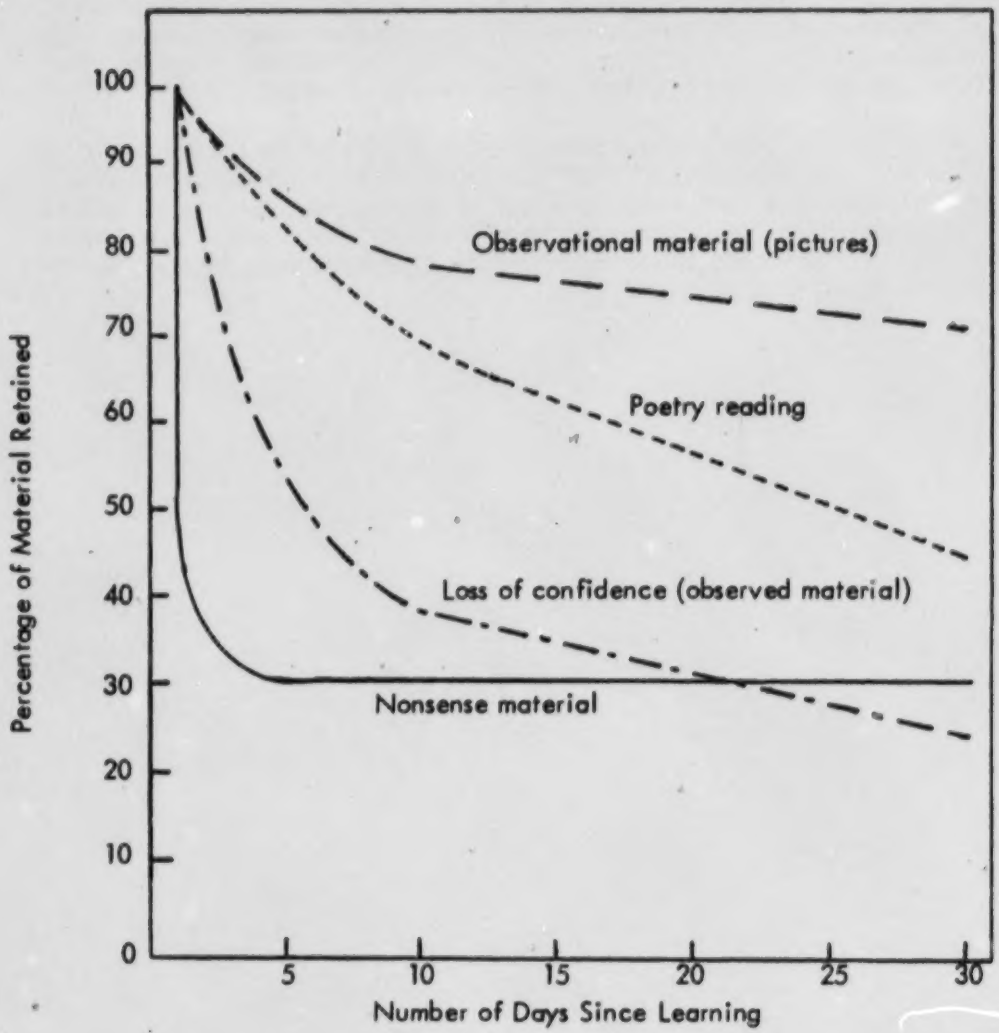

Figure 4. Rates of Forgetting for Different Types of Materials (16).

Applications of the findings of these studies to school work and their implications on student learning and retention can be seen in Tyler's work with students in biology and zoology (42, 43). He found that 15 months after students had completed their courses they had lost 76.8 percent of their ability to name animal structures, but that only 26.2 percent of their ability to identify technical terms had been lost and only 20.7 percent of general information had been lost. Surprisingly, there was an actual gain of 0.7 percent in their ability to apply biological principles to new situations and a gain of 24.8 percent in the ability to interpret new and previously unfamiliar experiments.

Overlearning

In order to maintain high learning levels it is necessary to reduce the amount of forgetting associated with the passage of time. One approach to increase the degree of learning calls for application of the "Overlearning" principle. In psychological circles "overlearning" calls for practice beyond the stage in which one performs the task for the first time without making an error.

Repeated studies have demonstrated that overlearning to the extent of 50 percent does increase retention and facilitate relearning. Similarly, overlearning to the 200 percent degree will increase retention levels, but there seems to be a diminishing return from the theoretical overlearning. As a result one cannot anticipate an ever increasing advantage from continued learning beyond the 200 percent degree of learning.

Chapter 5

COMPARATIVE LEARNING RATES

What children learn and the permanency of that learning is related to how the instructional time is distributed over the course of not only the school year, but over the full twelve months of the calendar year. The assumption has been that each child has an individual rate of learning in school. Due to a number of variables, a child's progress may appear to waver, but longitudinal studies will show that over extended periods of time a child's progress tends to be fairly uniform or continuous.

It is becoming increasingly clear that a child does not maintain the same rate of learning during the summer which was characteristic of in-school learning. Recent studies have shown that low achieving children are more seriously affected by the closing of school during the summer than average or high achieving students. Thomas C. Thomas and Sol H. Pelavin (40) have indicated that the differences in summer learning rates may be of major importance for the long-term performance or long-term retention of the different groups of students. It is their contention that during the school year, high and low achievers may be making very similar educational gains, but fail to maintain equal levels of achievement over the summer.

Measuring Rates of Progress

Student growth or lack of growth is often referred to in terms of evaluation scales. Some educators show a preference for percentile or stanine rankings since they show the individual's status in terms of a particular group of students for a selected subject or subdivision. Other educators often use grade equivalent scores because of their apparent simplicity.

Test makers establish grade norms by administering their achievement tests to students from several grade levels from various parts of the country. The mid-score is computed for students taking the tests at various grade levels. These median or average scores for designated grades are translated into grade equivalents. When the classroom teacher administers a battery of achievement tests, he or she compares individual pupil test scores with the scores shown on a table provided by the publisher. The pupil's grade placement for a designated subject or subdivision is referred to as his or her grade equivalent, expressed in decimals. A grade equivalent (G.E.) of 4.6 means the student is reading on a level comparable to the average student who is in the sixth month of the fourth grade.

Summer Achievement Losses

Early studies of the impact of the traditional summer vacation pointed up the fact that many children lost ground in reading and arithmetic during the summer; but with summer reinforcement programs the in-school gains were occasionally maintained through the summer. An analysis of the findings indicate that few, if any, disadvantaged children were included in the studies. In many cases, conclusions were drawn on the basis of a median score which failed to indicate the number of students who did not show summer gains or the extent to which they deviated from the local norm.

Table 3 shows grade equivalent losses and gains of students at selected percentile points during the summer vacation. The Beggs study (4) was based on data collected in the annual Iowa Basic Skills Testing Program in the state of Iowa. The tests were administered to students in grades 3 to 6, around April 15th and again around October 15th. It can be noted that students whose scores fell into the lower percentiles (05-20) tended to show losses in more skills than did those students in the higher percentiles. Interestingly enough, students in the 90 through 95 percentiles showed losses in reading comprehension, as well as reading and arithmetic skills.

Table 4 shows the observed and expected median grade equivalents for the in-school period of the Begg's study. Data bearing on the nature of summer growth were obtained late in May and early in September. Regular gains were found for the in-school periods of October through April. Losses were found to occur over the summer months (May through September). It would have helped if the study had shown the rates of progress for students who would fall into a disadvantaged classification.

Variation Among the Disadvantaged

Reading is the biggest hurdle that disadvantaged children in the primary grades have to clear. Frequently, they begin school with a limited language background, which may be a by-product of their total experiential background. As a result, it has been predicted that their achievement rate will approximate 70 percent of that of the average (50th percentile) primary grade student. If true, it leads to the projection of a two- to three-year reading retardation by the end of the sixth grade, or start of the seventh grade. This has been substantiated by Coleman and others. They found that disadvantaged children are entering junior high school in large numbers without the ability to read at the fourth grade instructional level. Figure 5 shows that this would be their expectation level if their reading progress did not exceed the projected seven months growth during the conventional ten-month school year (.7 G.E. growth rate times 7 school years equals a potential of 4.9 years of growth.)

Table 3

Changes in Grade-Equivalents at Selected Percentile Points During the Summer Vacation (4)

Subtest	%ile										
	05	10	20	30	40	50	60	70	80	90	95
Vocabulary	-1.8	-0.5	0.5	0.9	0.8	0.7	0.6	0.6	0.8	0.9	1.0
Reading Comprehension	-1.7	-1.3	-2.1	-1.3	0.8	0.0	0.0	0.0	0.1	-1.0	-1.0
Spelling	-1.0	-2.0	-2.6	-3.0	-2.5	-2.0	-1.0	-0.7	-0.7	-1.0	-0.8
Capitalization	-1.0	-2.0	-1.6	-1.5	-1.6	-1.7	-2.1	-2.0	-1.3	-1.3	-1.0
Punctuation	-3.9	-5.0	-5.8	-5.6	-4.8	-5.0	-5.0	-3.8	-1.8	-0.7	-0.6
Usage	-2.0	-3.3	-4.4	-3.5	-2.1	-1.8	-0.8	-0.7	0.0	0.0	0.0
Map Reading	0.6	0.7	1.0	1.7	1.8	2.0	2.0	1.6	1.9	2.0	1.0
Reading Graphs and Tables	2.0	3.4	2.9	2.9	2.1	2.2	2.0	1.8	1.5	1.4	1.0
Knowledge and use of Reference Materials	-0.5	-1.0	-0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arithmetic Concepts	-1.6	-2.3	-1.8	-2.0	-2.0	-2.0	-2.3	-2.3	-2.7	-2.8	-2.0
Arithmetic Problem Solving	-2.0	-2.0	-2.0	-3.6	-3.8	-4.0	-3.5	-3.7	-3.0	-2.9	-2.5

Table 4

Summary of the Observed and Expected Median Grade Equivalents for Interpolated Time Periods * (4)

Subtest	Sample	School-Year 3-4 Oct.	School-Year 3-4 Apr.	School-Year 4-5 Oct.	School-Year 4-5 Apr.	School-Year 5-6 Oct.	School-Year 5-6 Apr.	Summer 5-6 May	Summer 5-6 Sept.
Vocabulary	Exp.	40	46	52	58	60	66	59	60
	Obs.	41	47	51	59	60	67	59	60
Reading Comprehension	Exp.	41	47	52	58	60	66	59	60
	Obs.	39	47	52	57	61	67	58	58
Spelling	Exp.	44	50	54	60	65	73	61	62
	Obs.	42*	53*	55	64*	66	74	62	60
Capitalization	Exp.	46	53	56	64	66	77	64	65
	Obs.	47	59*	57	70*	64*	79*	66*	64
Punctuation	Exp.	45	51	56	63	68	78	63	65
	Obs.	45	58*	58	67*	66*	78	67*	62*
Usage	Exp.	43	49	53	59	65	75	58	59
	Obs.	43	52*	53	61	60*	71*	59	57
Map Reading	Exp.	44	52	53	60	64	71	64	65
	Obs.	44	52	53	61	67*	75*	62	64
Reading Graphs and Tables	Exp.	43	49	53	59	62	70	63	64
	Obs.	42	51*	54	62*	64	70	61	63
Knowledge of Use of Reference Materials	Exp.	43	49	53	60	63	69	64	66
	Obs.	42	51*	55*	62	66*	74*	64	64
Arithmetic Concepts	Exp.	44	52	55	62	63	70	61	62
	Obs.	41*	52	51*	64*	62	74*	65*	63
Arithmetic Problem Solving	Exp.	43	49	53	59	63	70	61	62
	Obs.	40*	51*	50*	60	61*	69	63	59*

*Significantly different at .10 level

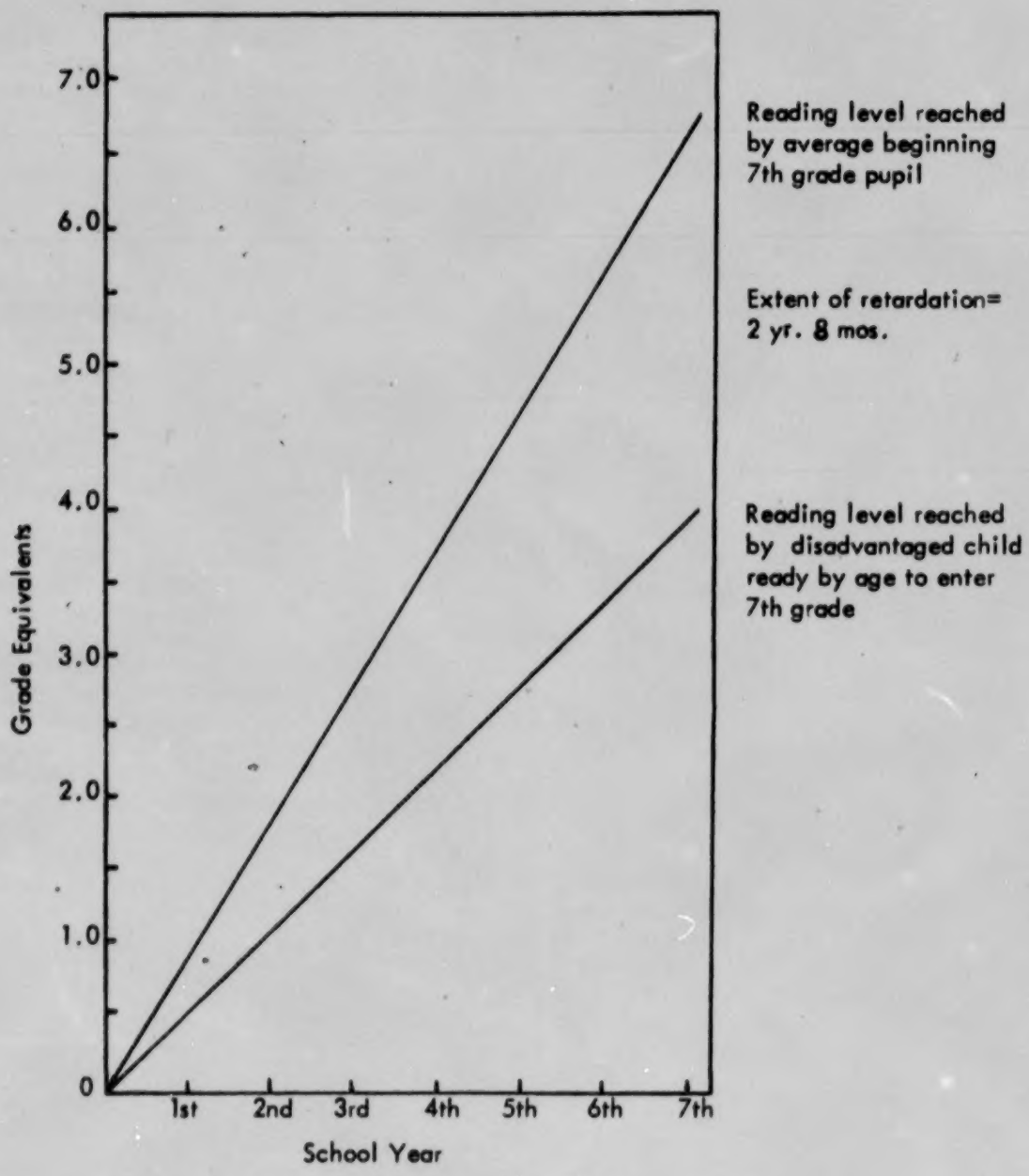

Figure 5. Comparative Reading Growth-Average and Slow Progressing Disadvantaged Pupils (39).

In order to demonstrate the success or failure of special programs it has been necessary to compare the progress of disadvantaged children who have been in a special program to those who have not received any special help. Earlier studies have shown that the average disadvantaged child makes no more than seven months progress during the nine- or ten-month school year. The gap between the achievement levels of average learners and disadvantaged children widens between September and June as well as over the span of several calendar years.

More refined studies support these early conclusions about the progress of disadvantaged children. As a result one finds the following statement in a report to Congress (9):

"According to the Office of Education, the educationally deprived child achieves an average of 0.7 of a year's growth for each year in class without the benefit of a compensatory program, such as Title 1."

Unfortunately, the true picture of the summer gains or losses tends to be obscured by the fact that few research studies of student achievement report on growth from fall to spring and then from spring to fall for a composite picture of the true growth over a twelve-month span. See Chapter 6.

Teachers who work constantly with disadvantaged children will concede that it is necessary to set aside four or more weeks in the fall for review activities in order to reach retention levels of the previous spring. What is frustrating to many teachers of highly disadvantaged children, who work in a grade- or class-oriented school, is the fact that teaching to a spring accomplishment level does not mean teaching on a grade expectancy level. For example, a third grade teacher who has no highly disadvantaged children should be able to have the less able students reviewing or completing a second level grade 2 basic reader (2-1) or its equivalent during September and October. By the middle of October or the first of November the reading group should be ready to begin a third grade reader. Meanwhile, students in the middle or top reading groups will have been reading in books designated as third or even fourth grade level materials.

In contrast the third grade teacher who is working with a class of disadvantaged children may be fortunate if a top reading group is ready to work at a first or second grade instructional level after a four to eight week review period in the fall. The disadvantaged child takes five years of schooling to accomplish what the average child completes during three years.

Forgetting - A National Issue

The appendix cites numerous studies going as far back as the 1920's which refer to educational losses over the summer. Other studies refer to losses of retention within a matter of months after completion of designated courses. These early studies refer to losses of learning but few use the term "forgetting." In the studies of the 1960's and 1970's there are numerous references to the lack of permanency of learning. Many of them imply children have reached prescribed performance levels prior to the start of a vacation. However, follow-up tests in the fall show students may be scoring lower on the post-vacation tests than they

did on the pretest. Again, there is the implication that there has been a loss of skills or knowledge, but the word, forgetting, is not mentioned in the studies as the contributing factor.

During the 1960's the nation was alerted to the fact that a large segment of school-age children could not read or compute with any degree of accuracy. School critics said that the children had not been taught or that the children were incapable of learning. This led to a demand for Federal funds to support special educational programs in an attempt to bring children classified as educationally disadvantaged to higher accomplishment levels.

The forgetting issue became a national one when evaluators of the first Head Start programs showed that gains in reading, and arithmetic were not sustained through the second and third grades. Here, again, one does not find references in the numerous reports, research studies and articles to forgetting, yet the fact remains that the loss of reading, arithmetic or language skills is synonymous with a loss of memory. In simple language the children forgot much of their prior learning and, therefore, were unable to reach higher education levels.

Time enters the picture because the retention of learning depends upon numerous variables when the children are not attending school. Events in time will have an impact on how much of the prior learning is retained as well as how receptive students are to new learning. Here again, numerous variables apply, such as the nature of the learner, the meaningfulness of the material, the degree of mastery of the initial learning, the amount of repetition and numerous other variables mentioned in earlier chapters. If the educational losses are due to forgetting, one has to go back to the theories of memory.

We have reached the point where it may be time for educators to take a new look at the educative process. Is review or reteaching the answer to the retrieval of lost learning? If one subscribes to the trace decay theory of memory, one should consider the educational losses over the summer as permanent losses. This implies that mere review will not suffice to regain prior accomplishment levels. If one subscribes to the permanence of learning theory of memory, we should consider the educational losses over the summer as temporary losses. The knowledge is still locked in memory and the issue becomes one of retrieval. This is where review in depth may be considered the answer to educational losses.

The forgetting problem is universal. All students, regardless of ability or background ultimately have to cope with it. However, lapses of memory occur more frequently or in a shorter period of time for some students than for others.

Nationwide, all educators are feeling the effects of longitudinal forgetting. Unfortunately, the degree of forgetting for most children is not extensive enough, while the children remain in school, to frighten or shock those providing financial support to schools. However, there is recognition among educators that a problem in forgetting exists, especially in the low educational performance of the students who normally score below the 50th percentile on standardized tests. As a result, schools are struggling to improve the education of the disadvantaged children.

Chapter 6

RETENTION OF LEARNING BY THE DISADVANTAGED

Billions of dollars have been expended in the past decade on programs which have demonstrated that many millions of children who have been categorized as noneducable are capable of learning. Again and again disadvantaged children have acquired new skills and knowledge only to find their gains have been rapidly dissipated over the months when schools were not in session.

This chapter will not attempt to justify what may or may not have happened in the classroom. The primary objective is to demonstrate that forgetting or low level retention is extensive. Projects designed to overcome educational and social constraints will be described and the outcomes of the projects will be discussed.

Head Start Program

Head Start was born during the mid-sixties, as an attempt to meet the special educational needs of millions of children, who for one reason or other were classified as disadvantaged children. One cannot fault the program as such, because the goals were good and still make sense. Initially, Head Start was conceived as a concentrated effort to prepare poor or disadvantaged children for early school experiences. In addition to its high educational goals, Head Start provided needed health care under a philosophy which stated that "healthy children learn better."

As described by Brazziel (6):

"Head Start attempts to provide a program which emphasizes educational development, health services and nutritional support, social and psychological services, and parent participation. The educational program emphasizes the development of vocabulary and word fluency, learning to express oneself spontaneously, familiarization with the routines of school, getting to know teachers and learning to relate to them, developing a broader concept of the world, and, developing an interest in books and reading. Classroom experiences are much like those in a nursery or kindergarten, and the development or readiness for later school experience is stressed."

Bloom's findings (5) had emphasized the importance of the child's before the beginning of school years as a time for intervention to change human characteristics. Head Start placed an emphasis on intervention at a stage in the child's life when intervention could be most effective.

Head Start began, first, as a new type of summer program; then in 1967, full-year programs were initiated. Evaluations pointed up the need to initiate compensatory programs to maintain children's early gains.

Accomplishments. The early evaluations of Head Start programs showed educational gains up to levels anticipated by their sponsors. Regardless of any negative aspects of the Head Start programs, consideration should be given to the fact that children who in prior years would have been classified as "too dumb" to learn, did learn. The children proved that they were teachable, which might be considered a victory that was long overdue. The development of a positive self-concept and sense of self-worth was listed as one of the major Head Start goals. Showing the children that they could learn, helped meet that goal.

Regression. The first signs that something was wrong appeared in the evaluations of the progress of children who had worked in Head Start summer programs. Many of these children appeared to be ready for the formal work of a designated grade only to find themselves falling behind children who had no prior Head Start experience. By the end of that first school year all of the advantages that the children had started with appeared to have been lost.

The gains made by Head Start children who were in full-time programs were more lasting, but even these gains were not sustained. There were a few exceptions, but for the most part children whose rate of accelerated development had given them an edge at the start of the school year found themselves being surpassed before the end of the first year by non-Head Start children.

Westinghouse Findings. Summer programs have been ineffective in producing gains in cognitive or affective development that can be detected by tests used in grades 1, 2, and 3. The evidence obtained in this study indicated that the statistically significant positive differences for summer programs are not only small in absolute number but also particularly small in the perspective of the total number of comparisons and measurements carried out. This limited positive impact was corroborated by the analysis of statistical significance of the finding (49).

Full-year programs are ineffective in promoting detectable, durable gains and are marginally effective in producing noticeable gains in cognitive development that can be detected by measurements used in grades 1, 2, and 3.

Head Start children, whether from summer or full-year programs, still appear to be in a disadvantaged position with respect to national norms for the standardized tests of language development and scholastic achievement.

Head Start appears to have had a positive effect on the parents of its enrollees. They voiced strong approval of the program and its influence on their children. However, the parents were not able to help children sustain educational gains over the summer either through direct action or moral support.

Commentary. The low retention may be attributed to a number of variables. For example, programs may have been poorly implemented or subsequent school environments may have nullified earlier gains.

Lack of maturation has been given as a reason for low retention of Head Start children when they entered regular programs. Perhaps a case in point may be faulty diagnosis of students readiness for formal first grade. For example, one major study reports failure of children in first grade to maintain prior educational gains. However, a look at the results of a Metropolitan Reading Readiness Test showed a median score of 51.74. This would place the children at the median in the

low average category or 42nd percentile rank. The Westinghouse study goes on to quote the test manual and states: "Average children are likely to succeed in first grade. Careful study should be made of the specific strengths and weaknesses of pupils in this group and their instruction planned accordingly."

Since retention of learning is contingent upon an individual's mastery of the skill in the first place, the Metropolitan Reading Readiness Test Scores would denote that the Head Start students were placed in first grade programs before they had attained a high degree of mastery of those skills necessary for success. High forgetting rates should have been expected for many of the students. Some of the Head Start students in the programs made it through their first year. However, their low socioeconomic backgrounds, ethnic background barriers, and a dearth of good reading books helped set the stage for a loss of learning over the summer which a review the following fall would not easily recapture. Even assuming their forgetting level to have remained at a plateau in the summer, these children would still have entered second grade with a need for continued instruction in first grade reading.

There is no evidence that former Head Start children progressed at the expected rate of seven months per school year, nor is there evidence that they remained at a plateau during the summers between first and second grade or between second and third grades. However, current evidence of children in special compensatory educational programs leads to the conclusion that summer regression was a potential causal factor for the steady deterioration of any early gains attributed to Head Start.

Follow Through

Congress established Project Follow Through in 1967 when it became apparent that lower elementary school programs were needed to articulate with Project Head Start which had been implemented earlier. The goals and approaches of the new programs were designed to meet the needs of economically disadvantaged children.

Deutch (13) is quoted as saying:

"Because of prior deprivation the disadvantaged child comes to learn and to profit less from the academic programs, as measured by standardized intelligence and achievement tests. As they continue in school, this gap between the disadvantaged and his white, middle-class peers widens. In short, the deficit at entry becomes cumulatively greater with each successive year."

Planned Variation Research. Follow Through was established as a "planned variation" research design in an attempt to test divergent educational and development theories. The U. S. Office of Education gave researchers and educators an opportunity to develop plans which would lead to higher educational achievement on the part of economically disadvantaged children. Twenty-two designs were found acceptable. Eleven designs were developed and tried in university settings, 8 were affiliated with private research institutions and 3 were community-developed programs. In 1968 the sponsors described their educational

models to representatives from school districts across the country.

Training programs were designed and put into effect. Workshops were held, generally for two weeks, during the summer. These were followed by weekly, semi-monthly or monthly inservice meetings, plus direct supervision. The sponsors were given 5 years in which to test their theories.

In order to determine the effectiveness of the programs, an evaluation instrument was designed. In 1969 it was found that the observation instrument was biased in favor of progressive education. It was revised so the new instrument was more objective and fair to all sponsor models. In subsequent years additional observations were made that led to further revisions.

Results. Follow Through has led to implementation of numerous changes in classroom organization and practices including involving parents and providing supportive services to Follow Through families. It has been theorized that some of the experimental aspects of the programs have contributed to the growth of children in Follow Through and to students in regular classrooms, but evaluative instruments have not always demonstrated that the changes produced were either positive or negative.

It is difficult to assess the true impact of Follow Through experimental programs because the initial goals of many programs were different. For example, some sponsors employed staff directors and teachers who were biased in favor of a child development approach. In their programs mastery of reading and math skills was secondary to the development of social skills. The result was biased in terms of activities which should have contributed to the development of self concepts and independence, but the final evaluations failed to demonstrate that their gains were sustained.

The University of Kansas and the University of Oregon Follow Through Programs were of a different nature. Here reading success was uppermost in the goal structure of the sponsors. As a result they established a structured program. It did produce higher academic gains in reading and arithmetic through the second and third grades. However, evaluations repeatedly indicated that projected or anticipated educational advantages or gains were either not significant or were not lasting:

"These displays provide little evidence that Head Start experience stimulated superior progress in kindergarten and first grade. Such evidence as we have suggests that academic gains appeared early and tended to dissipate. The data give no firm basis for discerning any difference between the performance of HSPV and 'home' treatment as pre-school treatments."

Since this retention study is not to be construed as an evaluation of the Follow Through Planned Variation Programs, no attempt is being made to defend or attack individual programs. However, the evaluations have repeatedly indicated that these special high cost programs tend to be nonproductive when the permanency of gains is considered, regardless of the underlying philosophy.

Time and length of the programs has been repeatedly mentioned. Thus, "One-year programs were less effective than two-year programs but gains were not significant in terms of non-Follow Through children. This was often mentioned for

parent school involvement as well as for cognitive learning."

Two interesting observations are worthy of consideration, notably:

(1) No significant interaction among the variables sex, sponsor and Follow Through/Non Follow Through was detected on nine outcomes. It therefore appears that respective sponsors do not have systematically differentiated effects for boys and girls.

(2) Black children do not respond in the same way to all sponsors' Follow Through programs, but the results indicate that children of one racial group cannot be differentiated to a greater extent than children of the other racial group in most schools.

Other retention studies have pointed up the fact that different teaching and different learning techniques lead to different degrees of learning and retention. The Follow Through Studies repeatedly produced greater gains than others. For example, Far West Laboratories Program is more effective with classes of higher than average initial achievement and less effective with classes of lower initial achievement.

The early evaluations of Head Start Planned Variation reported larger gains on the part of the regular Head Start pupils. These students entered the programs with significantly higher scores on the preacademic and general cognitive measures than did children with no prior Head Start. Similarly, children of relatively low socioeconomic status made significantly larger gains in general cognition during the year of Head Start than did children of relatively higher status, reducing, but not erasing initial differences.

Commentary. Head Start and Follow Through Planned Variation Programs allowed educators to explore a large number of teaching and learning strategies. Unfortunately, problems of implementation, staffing and evaluation interfered with the realization of different goals and objectives. Any final conclusions depend upon so many variables that it is difficult to make conclusions about the effectiveness of specific types of sponsored programs without a better agreement on the program goals.

Positive proof exists of the teachability of disadvantaged children. They are capable of learning and with appropriate instruction can achieve educational gains greater than children with similar backgrounds who did not have the advantage of being involved in the special compensatory program. Numerous studies have shown that Head Start has a clear and strong short-term effect on cognitive outcomes.

One school of thought holds that the Planned Variation results generally confirm other findings that differences in educational resources in schools have no considerable or consistent relation to differences in school achievement. In contrast other educators contend that school results are modified or improved when goals are positively defined. No matter what the philosophy, the fact remains that different program strategies seem to have made little difference in the final results obtained.

Time for schooling and time in school have been considered as basic elements of the learning process, but time itself is not an answer to the problem of educating children, especially those who fall into the disadvantaged category. What these children learn and how much is learned depends to a large extent upon the nature of the program and how the children are taught. The following illustration briefly shows differences in the rate of growth by comparable groups of children who were exposed to three different types of programs.

The Fernald Program (15)

From 1966 to 1969 the Fernald School at the University of California carried on a research and demonstration program which provided remedial instruction to an advantaged and disadvantaged group of children who had similar learning disorders. One object was to determine if the same remedial program was equally effective with disadvantaged and advantaged children. A second objective was to compare the Fernald disadvantaged childrens' achievement to that of two similar disadvantaged groups — a group that received some special reading instruction at their home school from Fernald teachers (The Enrichment Group) and a control group that received no special treatment.

Program Differences

The Fernald School Program. Children who attended the Fernald School were exposed to a very highly individualized program. Teacher-pupil ratios were very low and the setting for learning was designed to enhance both the academic and nonacademic needs of the students. The key to learning started with an assessment of each child's specific problem and his or her needs. The subsequent learning activities were aimed at helping the individual experience success where formerly he or she had experienced nothing but failure. Individual diagnosis was continuous and programs were altered as new strengths and weaknesses were discovered.

The emphasis was placed on the basic skills of reading, languages, and arithmetic and an attempt was made to give students skill development activities which fitted each student's strongest subject area interest. Each student also took part in a daily physical education program and a variety of special activities such as art, music, drama, crafts, and discussion groups.

The Fernald Children. The children were all at least 1.5 years below the national norm in reading achievement, were of normal intelligence, and were free from severe emotional and neurological problems. The groups were matched with respect to age, I.Q., and severity of learning disability. Roughly half of the children were between the ages of 8 and 12; the other half were 13 and 14 year olds.

The advantaged children were selected from families who had money enough to pay tuition. They came largely from upper or middle-class white families. The disadvantaged children came from an area of Los Angeles where the average annual income was $3,000. Two-thirds of the children were black. The remaining third were Mexican-American or white.

The Enrichment Group. The enrichment group children attended three different schools and received special instruction from visiting Fernald teachers. The sessions totaled three or five hours per week. The special sessions supplemented students' regular reading instruction during the first year. During the second year, the Fernald teachers took over the entire reading program, and in the third year the Fernald teachers worked to assist the full-time aides who worked with the small groups of students.

The enrichment program called for individualization of instruction and the same techniques that were used in the Fernald School. Regular classroom teachers were encouraged to observe the effects of the diagnostic approach to learning. Consultation meetings were held with teachers and parents in an attempt to plan and guide future learning activities. Preservice and inservice meetings included workshops, lectures, consultations and visitations. Special videotapes were prepared to help the regular classroom teachers see and understand how actual on-going problems were solved.

The Control Group. These children worked in their regular classrooms and were not exposed to the Fernald teachers or their teaching activities.

Achievement Test Results

Statistical comparisons of the advantaged and disadvantaged children who worked in the Fernald school indicated that:

1. The gains made by both the advantaged and disadvantaged children as a result of the Fernald methods were comparable. The differences were not significantly different.

2. The gains made by the Fernald disadvantaged children were significantly different than the gains made by either the control or enrichment groups.

3. The gains made by the control and enrichment groups were not significantly different from each other.

The Fernald groups made grade-equivalent gains of approximately one year during the nine months between test administrations, while the other groups made gains approaching seven months (See Tables 5 and 6). Since the Fernald group gains exceeded those expected of average (50th percentile) students, their gains can be considered educationally as well as statistically significant.

Table 5

Gain in Composite Mean Grade-Equivalent
Scores on the California Achievement Test
(Data Pooled Across Academic Years) (15)

Grade	Gain	Fernald Advantaged	Fernald Disadvantaged	School Enrichment	Control
Elem.	Mean Gain*	1.08	1.06	0.68	0.75
	N	32	28	39	36
Jr. High	Mean Gain*	1.04	1.10	0.57	0.52
	N	28	28	28	27
Total	Mean Gain*	1.06	1.08	0.63	0.65
	N	60	56	67	63

*Based on a composite of three subtests for reading, arithmetic, and language, each of which had two subscales.

Table 6

Mean Gain in Grade Equivalent Scores
On the California Achievement Test by Subject
(Data Pooled Across Academic Years) (15)

		Fernald Advantaged	Fernald Disadvantaged	School Enrichment	Control
Elem.	Reading Mean Gain	0.98	1.02	0.74	0.74
	Arith. Mean Gain	1.12	1.05	0.74	0.74
	Language Mean Gain	0.94	1.15	0.87	0.77
Jr. High	Reading Mean Gain	1.02	.90	0.56	0.58
	Arith. Mean Gain	1.07	1.07	0.49	0.40
	Language Mean Gain	0.98	1.20	0.54	0.53
Total	Reading Mean Gain	1.00	.96	0.67	0.67
	Arith. Mean Gain	1.10	1.06	0.63	0.60
	Language Mean Gain	0.96	1.18	0.73	0.67

Noncognitive Results

The results of the pre- and post-test for anxiety showed that all children who participated in the Fernald Program manifested a decrease in anxiety. The Fernald disadvantaged group had the largest decrement, but none of the differences were statistically significant.

The Vocational Checklist showed that the Fernald junior high school boys did not have any higher vocational goals than they had at the beginning. The elementary school disadvantaged boys did show an elevation in aspiration reliably greater than the advantaged group.

The Ethnic Attitude instrument failed to show any significant differences between the Fernald disadvantaged and the enrichment and control group students. When the result of the attitude survey were examined, no valid conclusions were possible.

The special Fernald School research study demonstrated the effectiveness of a special compensatory program of education upon disadvantaged children. During the in-school months,the Fernald disadvantaged students showed that month for month they were able to achieve as well as the advantaged students who had the benefit of the fully individualized and diagnostic school sponsored activities. On a comparative basis with other disadvantaged children who started on parallel learning levels, the Fernald group exceeded the other groups. Month for month they appeared to have exceeded the achievement levels anticipated for average advantaged children and definitely showed their superiority when their rates of achievement were measured against other disadvantaged children who did not have an opportunity to work in a comparable compensatory program.

Mother-Child Home Program

The goal of the New York State Mother-Child Home Program (23) was to increase the I.Q.'s of two and three year old disadvantaged children by increasing their verbal interaction with their mothers. The children involved in the Special Treatment Program and those in the two comparison groups came from three separate, low income public housing projects on Long Island. Instruction between child and mother was structured through periodic home visits by trained interviewers. They provided toys and books as stimulus materials for verbal interaction.

During the first year of the program, the treatment children were visited by professional social workers who had been trained to help the mothers work with the children. Children in the first comparison group "were visited by a kindly adult figure" on the same schedule as the treatment children, but the visitor made no special effort to increase the language facility of the children. The second comparison group of children was subjected to both the pre- and post-test, but did not receive any visitors or special help.

The Peabody Picture Vocabulary Test (PPVT) and either the Stanford-Binet or the Cattell Infant Intelligence Tests were used to evaluate the program. Table 7 shows that the treatment or experimental group made large and significant gains that were not matched by either of the comparison groups.

Table 7

Summary of Cattell/Stanford-Binet I.Q. Status
Before and After Program Treatment 1967-68 (23)

Treatment (N=33)		Mean I.Q.		Differences	
		C_1(N=9)	C_2(N=11)	T-C_1	T-C_2
Pretest	84.9	87.4	92.0	-2.5	-7.1
Posttest	101.9	88.4	94.0	+13.5*	+7.9
Gain	+17.0**	+1.0	+2.0	16.0**	+15.0**

*p .05, Two Tailed.
**p .01, Two Tailed.

T = Treatment Group
C_1 = First Comparison Group
C_2 = Second Comparson Group

Seventeen of the original treatment group children had no further contact after their involvement in the seven-month program, other than follow-up tests which were administered 30 months after the original pre-test. At that time they showed a mean general I.Q. gain of 12.7 points as compared to the 17 point gain they had made on the first post-test. On the PPVT they showed a 14.1 point gain as opposed to the 15 point gain they showed immediately after the treatment. Both gains over the long period were statistically significant (p.01).

Over the same 30-month period, the untreated comparison group (C_2) showed a general I.Q. gain of 2.3 points (nonsignificant) and a PPVT I.Q. gain of 12.0 points (p.05). These gains were somewhat difficult to explain since five children were included in the follow-up test for whom there had been no pre-test.

Nine children of the original treatment group participated for a second year to the extent of receiving additional verbal interaction stimulus materials (VISM). They did not show any additional I.Q. gains.

Another five children from the original treatment group were given additional VISM exposure plus nine home session treatments during the second year. At the end of the first year, this special group had shown an I.Q. gain of 18 points. At the end of the second year the tests showed an I.Q. gain of 24.8 points. Their second year PPVT I.Q. gain increased from 9.6 points at the end of the first year to 20.8 points at the end of the second year.

Similar gains in I.Q.'s were made for students from the original comparison groups and by students who were introduced to the program in the second and third year. While nonprofessional women of varying income and education were trained to replace the original social workers, the end result was the same. The Mother-Child Home Program demonstrated that it was possible to produce statistically significant I.Q. gains in children.

Project Conquest (48)

The three goals of Project Conquest in East St. Louis were:

1. To raise the reading ability of disadvantaged children to the point that they could function successfully in their regular classrooms;

2. To improve the children's self-concepts and academic aspiration;

3. To train regular classroom teachers in remedial reading techniques.

The Children. The children who took part in Project Conquest came from an economically deprived section of East St. Louis. Over 80 percent of the inhabitants were black, and fifty-one percent of the adults earned less than $3,000 a year. Over 20 percent of the workers in the city were unemployed and it was estimated that the unemployment rate was 30 percent in the depressed areas where the children lived. Children who were reading one or more grade levels below grade level were recommended by classroom teachers and principals to take part in Project Conquest.

Each child was carefully examined to determine the nature of his or her language and reading deficiencies. If the programs indicated that the student required remedial help, he or she was admitted to either a reading clinic or a special reading room.

The Teachers. The key element in the reading project was the reading teacher. Prior to the actual start of the project a number of regular classroom teachers were assigned to one of the four special reading rooms that were established. The reading room teachers worked with children who came to them in small groups. The teacher diagnosed student needs and provided direct reading instruction. Remedial instruction was provided in 45-minute sessions for four days a week in the reading rooms and for two days a week in the clinics.

Teacher aides were assigned to each clinic after they had undergone inservice training with the clinic teachers. The aides had earned at least 30 hours of college credit. The noninstructional tasks they accomplished helped free teachers for instruction. School community aides who volunteered for the project worked without pay. They were able to establish a rapport with parents, help the parents understand project goals, and encourage parents to meet children's reading-related needs at home.

The Program. Frequently, children were given individual reading instruction based on careful diagnosis. As they encountered successes and gained in self-confidence they were assigned to work in small reading or language groups. Special supervisors

worked with home room teachers to help coordinate regular classroom activities with reading room or clinic activities, and helped the regular teachers select appropriate reading materials for use in the classroom.

Joint inservice training meetings were held weekly for all reading staff in which they reviewed old teaching techniques and learned new ones. They learned to work with video tape recordings and other special equipment and materials. In addition, formal and informal training sessions were held with regular classroom teachers from the twenty-six home schools.

Reading Achievement. During the 1968-69 academic year, 1250 students worked in the program. Pre- and post-tests were administered to 1055 students. A random sampling of 42 students was selected for evaluation purposes. Since the time interval between pre- and post-test was seven and one-half months it was estimated that "average" advantaged children without reading disabilities would be expected to gain seven and one-half months in reading grade equivalent units. The sample's grade equivalent mean gain of .94 was considered statistically significant (p.025).

In 1969-70 a larger scale analysis was made. A random sampling of 355 students was selected from the 987 students who had taken pre- and post-tests. These pupils took the Gates Primary Reading Test, the Gates Advanced Primary Reading Test or the Gates Reading Survey as the pre-test in September of 1969. The comparable Gates - MacGinitie Reading Test was administered in May 1970 (See Table 8). Both the reading room and clinic students made statistically significant gains in reading. There were no differences found between these two groups.

Table 8

Mean Reading Achievement Gains Made By
Project Conquest Students in
1969-70 (42)

	N	Pretest	Posttest	Gain
I. Reading Room				
1	17	2.02	2.79	.77*
2	24	2.13	2.95	.82**
3	24	1.61	2.76	1.15**
4	22	1.29	2.33	1.04**
II. Clinic				
A	110	3.17	4.21	1.04**
B	99	3.35	4.63	1.28**
C	59	3.57	4.37	.80**

* p .05, one tailed t test.
** p .01

A review of the literature on compensatory education indicates considerable evidence in support of the thesis that the special programs can be most productive in short-term effects as measured by standardized intelligence and achievement tests given at the end of the programs. Unfortunately, the evidence for sustained effects, based on evaluations made after program participation, repeatedly show that most cognitive gains made in preschool disappear by the second or third grade.

To a lesser extent, studies report short-term gains for intermediate grade programs, but there is little material on programs involving pupils beyond grade six. Again, the literature continues to report on what appears to be short-term effectiveness. When it comes to the long-term effectiveness of most compensatory programs, one has to search hard and long for evidence of an acceptable nature. While there are several reasons for this, one has to face the fact that many of the compensatory programs have been limited in terms of the demands for extra help. This is evident in the numerous complaints that students who appear to have made desired educational gains during a designated school year are replaced the following year by other disadvantaged students in need of special assistance. As a result it is difficult to obtain hard evidence that special programs produce educational gains which will be sustained over several years.

Those responsible for the implementation and evaluation of special compensatory reading, arithmetic and bilingual programs have repeatedly produced sample test results which speak well for their programs. Unfortunately, the evidence is faulty in that the gains are not lasting. For example (33):

"State Title I evaluations show that students in Title I programs achieve at much higher rates than expected during the in-school year sessions. This finding is not supported, however, by data from statewide testing programs. Since the advent of Title I, there are no detectable increases in the scores of those most likely to be Title I participants. . .the low percentile students."

The educational losses in Head Start, Follow Through and Title I projects clearly demonstrate that students composing a large segment of the disadvantaged school population forget much of their learning if it is not used purposefully in meaningful situations. The fact that the students showed educational growth indicates that they were teachable.

Frequency of Testing

The customary, once a year, district-wide testing permits fall to fall comparison. Title I program plans generally involved fall to spring change. Recently some research has been done to add a summer test, making testing available at three points within twelve months. Continuing the practice annually has made it possible to trace changes in groups over several years.

Fall to fall. Since not all compensatory programs have produced gains in reading and arithmetic between the pre-tests administered in the fall and the post-test administered in the spring, one cannot generalize to say that all Title I students gain during the in-school session. However, there are studies which show that up to 90 percent of the disadvantaged children made acceptable gains, but that as many pupils showed summer losses.

Pelavin (33) claims that:

> "Students with large in-school year gains were likely to have large summer losses. In contrast students who had small in-school gains were likely to show small summer losses."

Pelavin was interested in determining whether there was a relationship between the amount of gain achieved during the year and the amount lost over the summer. To do this, he examined data from Long Beach, Santa Barbara and Omaha. His calculations resulted in a correlation of approximately -.2. He concluded that there was a true relationship between the in-school gains and the summer loss, one that is probably within a range from -.1 to -.5. (Correlations in educational research as large as -.5 are rare.)

These findings raised the question of whether summer losses would result in changes in student rank between the spring and the second fall testings. Followup studies showed that fall to fall gains increase as school year gains increase. This led to the conclusion that even though students with large gains over the regular school year have large losses over the summer, the losses are not proportionately larger than those for students who have small gains over the school year. Therefore, the ranking of students, especially at the high school level, by size of gain at the end of the school year is similar to their ranking at the end of the summer.

Fall to spring. One of the established goals for compensatory programs has been to move disadvantaged pupils closer to national grade norms or achievement levels reached by advantaged children. The lack of test data from control groups has led to the use of a hypothesized seven months' growth per year for disadvantaged pupils who are not in compensatory programs. This rate of growth has been a yardstick against which compensatory program students are measured. Success is claimed when the treatment students show that they have made progress at a rate in excess of one grade equivalent point per school month. (One month's growth for each month of instruction.)

An achievement summary found in the New York State Annual Evaluation Report for 1974-75 fiscal year (47) illustrates what appears to be evidence that compensatory programs are successful. For example:

1. The group mean for 5,371 upstate second graders indicated a reading growth of 1.36 months for every month of Title I treatment.

2. The group mean for 11,982 New York City second graders indicated a reading growth rate of 1.18 months for every month of treatment.

3. The mean achievement rates for over 35,000 New York City public and nonpublic pupils participating in total reading treatments lasting more than three months ranged from 1.06 to 1.84 months growth for each month of ESEA, Title I treatment.

4. The New York City total mathematics test scores obtained from participants tested with norm-referenced devices indicated that participants, who began the program with a rate of growth of less than one month (about .7 or less) per month of instruction were achieving at a rate of more than one month (about 1.2 months) per month of Title I treatment.

Results such as the ones listed have been received from every state. On the surfact it would appear that the gap between achievement levels of disadvantaged children is narrowing. Project "catchup" should be recognized as something more than a dream.

The Need to Include a Third Period in the Evaluation of Compensatory Programs

Retention or, rather, the lack of retention over the summer appears to be the issue when claims for success of compensatory programs are made. Evaluations of these programs are showing that generally the gains are not permanent. Pelavin (32) recommends the inclusion of the summer months if one wants to demonstrate the success of the compensatory programs. Unfortunately, evaluations which include the third time interval (the summer) often considerably reduce estimates of achievement and hence monthly achievement rates.

Table 9 illustrates the loss in retention that occurred over the summer as measured by fall testing after the summer vacation.

A study prepared for the National Institute of Education by Stanford Research Institute attempted to show the long-range effectiveness of selected compensatory education programs. In order to show the permanency of Title I gains, standardized tests were administered over three learning periods. Table 10 shows designated California Test of Basic Skills reading means. The grade seven fall to spring means showed a gain of 1.3 grade equivalents. When a comparison between the spring mean and the following fall is made, it becomes clear that there was a loss of 2 months (.2) of the initial fall to spring reading achievement gain.

By the same token, the eighth grade fall #1 to spring gain was 1.0, or better than one month per month, for the in-school months. When the second fall test mean is included, the summer loss of .3 grade equivalent units is revealed.

Longer trends. Numerous research studies have verified the fact that there is a gap in the achievement levels of disadvantaged and nondisadvantaged children (Coleman (7), Mayeske (25)). This report has attributed the differences to the slower rates of achievement in school subjects such as reading and arithmetic during the in-school months. Thus, a rate of progress of 70 percent leads to the conclusion that disadvantaged children who have not been exposed to a Title I reading treatment are likely to be reading on a fourth grade level when they enter seventh grade. Compensatory reading programs have demonstrated that it is possible to raise the learning rates of disadvantaged children to a point where learning rates of disadvantaged and advantaged children are on a par.

Table 9

Gains and Losses in Achievement on the California Test of Basic Skills (CTBS) Over Three Time Intervals (32)

		Grade 7 Fall #1	Grade 7 Spring	Grade 8 Fall #2
Mathematics				
School A	Grade Equivalents	5.1	6.4	5.8
	Standard Scores	413	459	439
	Percentile	14	26	15
School B	Grade Equivalents	5.9	8.1	7.1
	Standard Scores	445	523	489
	Percentile	27	56	34
Reading				
School C	Grade Equivalents	4.6	5.8	5.1
	Standard Scores	415	456	427
	Percentile	14	20	10
School D	Grade Equivalents	5.5	6.5	6.0
	Standard Scores	444	478	459
	Percentile	23	28	19

Table 10

Santa Barbara California Test of Basic Skills
Reading Means and Gains for Two Time Periods (32)

Sample	Means			Gains	
	Fall #1	Spring	Fall #2	Fall to Spring	Fall to Fall
Grade 7					
Grade Equivalent	4.3	5.6	5.4	1.3	1.1
Percentile	12.	20.	16.	8.	4.
Grade 8					
Grade Equivalent	5.5	6.5	6.2	1.0	0.7
Percentile	16.	23.	16.	7.	0

The illustrations of summer losses shown in Figure 1 and Tables 3 and 4 raise a question. Do the summer months represent differences in levels of retention or differences in rates of growth between advantaged and disadvantaged children? So far, the hypothesis of a summer slump seems to be acceptable to many people. However, if learning consists of fluctuations in learning through forgetting, relearning, forgetting and relearning the differences in levels of reading achievements still remains a matter of learning.

Hayes and Grether (18) reported that as much as half of the final elementary school differentials in reading achievement were attributable to nonschool periods, including the five summer vacation periods between first and sixth grades. This leads to questions about the contributions of in-school and nonschool factors to learning. Thus, if reading differentials are mainly the product of out-of-school factors, e.g., the abundance or absence of suitable reading materials and adult readers at home, it would appear that a larger differential in achievement would take place during the summer between advantaged and disadvantaged children.

Hayes and Grether as well as Hayes and King (19) studied test results of some 380,000 New York City school children from grades two through six. The statistics were derived from Metropolitan Achievement Tests administered in the fall and spring for two successive years, 1965-66 and 1966-67. (Some 54,000 students of Puerto Rican background were not included because of their language deficiencies.) The researchers used school census data to ascertain the number of white, black, Puerto Rican and Oriental pupils in each school and neighborhood. Data about the number of students receiving free lunches provided some index as to the socio-economic status of the children. These two pieces of additional information allowed the researchers to stratify students into six subsets, each relatively homogeneous, but quite heterogeneous across sets from test data from 603 elementary students.

Set I schools contained the poorest students, as well as the largest number of black and Puerto Rican children. Set VI schools had the fewest poor children and a student body composed mostly of white children.

Analysis of the achievement of second grade children at the beginning of the year showed a .74 year difference between lower Set I and higher Set VI average scores. This differential between adjacent sets generally grew with each successive test and was the apparent consequence of differential rates of developing reading skills. The 2.72 year differential between the disadvantaged and the advantaged pupils merely reaffirms the initial statement that disadvantaged students will be working at a low fourth grade level when they begin the seventh grade year.

Further data analysis of the 1965-66 statistics led to the conclusions that:

(1) Twenty-eight percent of the 2.72 year differential between sets I and VI could be attributed to events which had taken place by the time of the first test.

(2) Forty-six percent of the reading differential was associated with whatever contributed to the within school differentials.

(3) The final twenty-seven percent was attributable to the vacation periods.

(The total exceeds one hundred percent due to rounding.)

For 1966-67 the values were nearly comparable to the previous year, being twenty-seven percent, forty-two percent, and thirty-one percent, respectively, or a disparity of 2.45 years at the end of the sixth grade between Sets I and VI.

In terms of monthly gains, the statistics show that the wealthiest students, (all white schools, Set VI) progressed while in school at a rate of only 1.3 times the monthly rate of the poorest students (all minority schools, Set I) in both years. By contrast, during the summer, Set VI children progressed at a rate of six or more times the rate of Set I school children.

The seriousness of data such as that shown in Figure 6 cannot be ignored since the summer losses are not limited to one year. The losses in retention are cumulative. Data from one New York City School District (34) showed disadvantaged Title I students made a composite gain of 3.053 (Gross Total Average) in arithmetic over three calendar school years. (See Figure 7.) In terms of the seven months growth per year anticipated for non-Title I disadvantaged children, the compensatory program had gone a long way towards closing the gap between disadvantaged and advantaged children. Unfortunately, the adjusted mean loss of .850 represented a 28.5 percent average summer loss for a net three year gain of 2.203. If the loss is included in the program evaluations, it would appear that the students in the Title I compensatory program failed to retain more than the equivalent of the seven months growth per year in arithmetic, over an extended three-year period, that they would have achieved without a compensatory program.

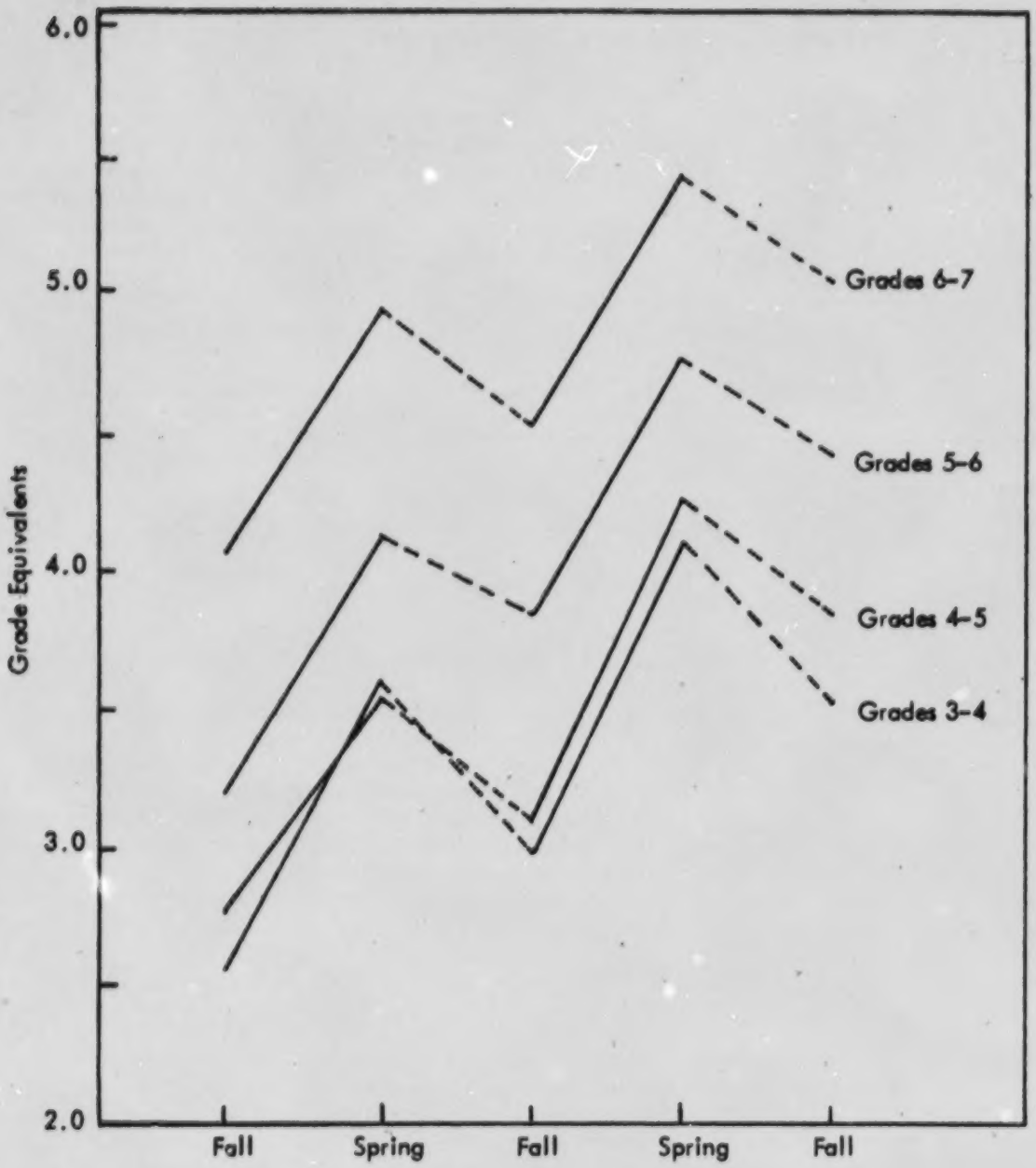

Figure 6. School and Summer Rates of Progress of Disadvantaged Title I Children (33).
(Means in grade equivalents for the Gates-Mac-Ginitie Reading Test for public school students)

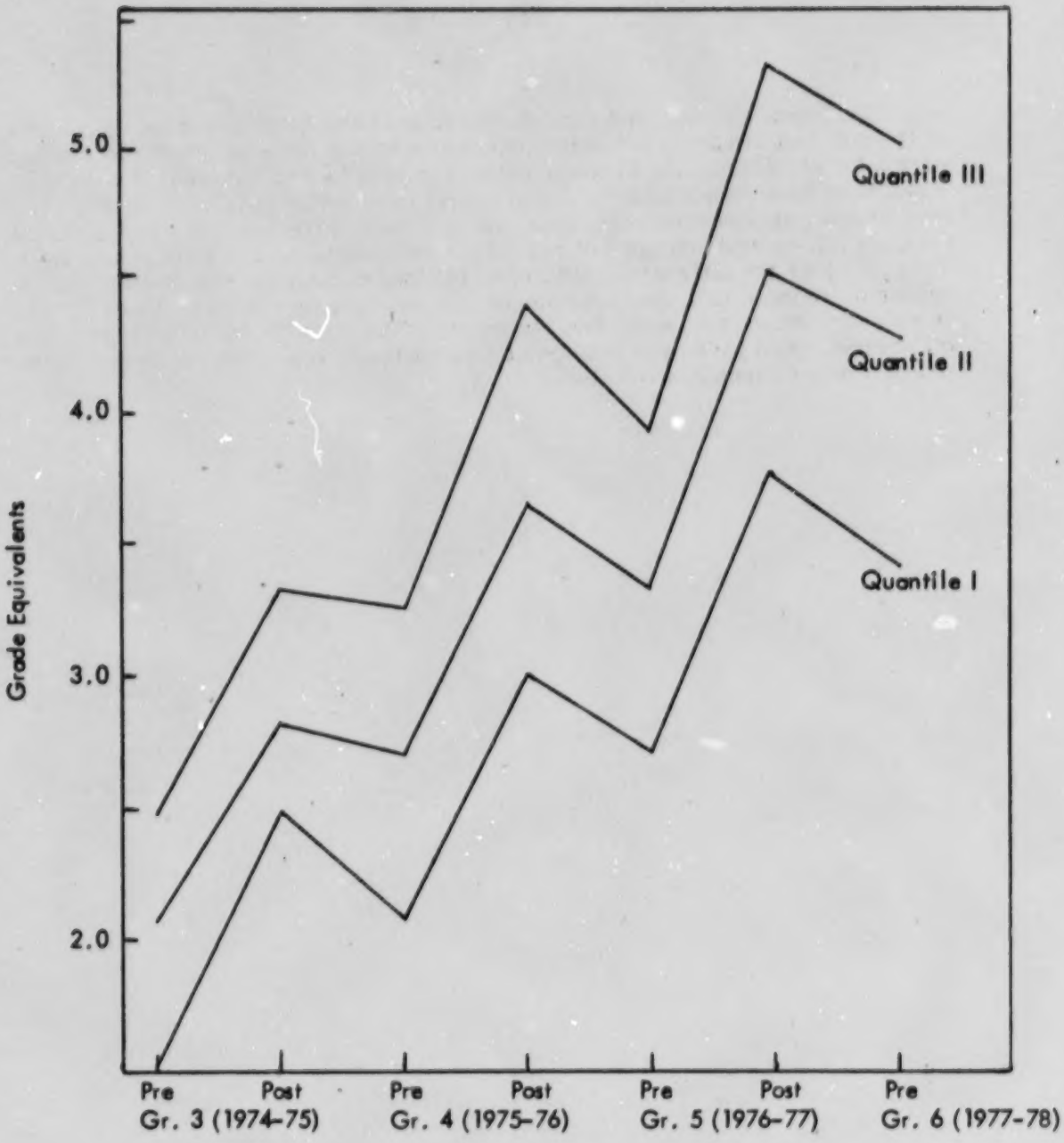

Figure 7. Comparative Growth in Achievement of Disadvantaged Students Working in a Special Title I Mathematics Improvement Program from Grades 3 to 6 (34).

Commentary

The Hayes, Grether, and King studies raised some questions about the quality of the fall test results which infer that the in-school rates of growth in reading were inflated. If true, the in-school rates of growth for the disadvantaged children would have been slower and the out-of-school rates would have been higher. The researchers expressed concern over the 2.7 year difference in reading levels between the poorest schools and the wealthiest schools at the sixth grade level. They said that the differential has important implications for the students' future academic success and life chances in the occupational market place. The researchers concluded with the statement, "Our results indicate that these differences would have been even greater had summer vacation been longer or the school programs been less effective."

Chapter 7

SUMMER SCHOOLING AND CALENDAR INNOVATIONS

Traditional School Calendar

The 20th century found the major cities of New York State with a school calendar of 200 days. In rural areas the school year ranged from 140 to 180 days. The desire for a uniform calendar — equal time for all students — led to legislative adoption of a 180-day school year. Social and economic factors were major considerations. No scientific study regarding learning, memory, retention and forgetting appears to have been made. The school year is now similar in all fifty states.

Changing Times

During the 19th century the needs of an agricultural society had dictated when schools should be open and when they should be closed. The 20th century brought an end to ruralism. Technology drew millions from the farm to the city and then new forms of transportation took them into the suburbs.

Leisure time was a product of the new society. On one hand the individual had the time and inclination for vacations, and on the other hand entire industries grew up to cater to vacationers' needs. In the northern states, if summer is to remain play time, the schools have to remain closed.

In recent years industrial and business labor contracts have been guaranteeing workers as many as four weeks of vacation time. Some of these contracts stipulate that workers must segment the vacations or limit their vacations to no more than two weeks at any one time. One argument for distributive vacations is worker efficiency. Industrial production depends upon the ability to provide workers with a change of pace. To some extent the same argument may apply to children's learning needs.

Summer Schooling

Summer schools date back about one hundred years. Originally, a major purpose was to permit students who failed a subject during the regular year to make it up. Later, summer sessions were also used to enable acceleration for gifted students and enrichment for the talented, e.g., music, art, crafts. Such summer programs were optional. Generally, the expansion of summer programs has

been slow, due to tradition and increased costs involved. Prolonged or extended periods of school and work without vacation breaks are not productive and can be actually harmful. It is also common knowledge that a one or two-week vacation or change in activities revitalizes the individual. Tensions may be eliminated and earlier barriers to learning may be overcome more readily. Mental as well as physical fatigue may no longer be a problem for student and teacher. However, it would appear as though the twelve-week summer vacation built out of the conventional school calendar is a threat to the retention of learned knowledge of at least 40 percent of the nation's children. Several different plans have been tried both within limited specified school days and without restrictions.

A few individuals have attempted to measure the amount of educational loss that can be attributed to a three-week vacation. For the most part they have reported some students as losing knowledge and skills while other students have shown gains especially in reading. Such variations may be expected where the children represent a cross section of society.

Similar results were found in Johnson's 1976 study (22) in which she measured the gains and losses following a four-week summer vacation.

Johnson compared pre- and post-test results for reading and arithmetic of students who had been on vacation for four weeks. One group of students had attended a school operating under a conventional or regular school year calendar. These children voluntarily returned to school to take Metropolitan Reading and Arithmetic Tests four weeks after their schools had closed and a summer vacation had begun. The second group of children had attended a school operating under the 45-15, all-year school plan. The group tested had just completed a four-week vacation so one of the objectives was to determine whether they had a better set for learning because they knew that they would be returning to school after four weeks, while the regular school year pupils knew that they would not. The comparison of the test results failed to indicate that the regular school year children lost any significant amount more than the all-year school students.

The Johnson study of two average groups of children following a four week vacation revealed that some students had experienced greater losses in reading and/or mathematics than other students. In contrast, other students had actually made gains. This is shown in Table 11 in the lower post-test arithmetic means for the regular school year males and the higher post-test means for the 45-15 plan males. In contrast, the regular school year arithmetic mean for females is higher than their pre-test while the post-test mean for the all-year school females is lower than the pre-test mean. A reverse situation occurs in reading. This study shows that losses and gains did occur with the four-week vacation, but the refined test for covariance failed to indicate that the differences met the .05 level of significance.

Table 11

Comparative Achievement of Regular and All-Year School Fifth Grade Children Following a Four-Week June Vacation (Metropolitan Achievement Test) (22)

	Mean I.Q.	Pre-Test Means		Post-Test Means	
		Reading	Arithmetic	Reading	Arithmetic
Conventional Year Students					
Males	94.78	23.00	23.36	22.21	20.00
Females	102.35	26.25	21.41	23.71	22.76
Total	98.93	24.77	22.29	23 03	21.52
All-Year School Pupils					
Males	95.10	21.50	15.45	19.90	17.15
Females	103.09	24.82	19.00	27.09	18.36
Total	97.93	22.68	16.71	22.45	17.58

Flexible School

A new and different approach was used in the ABC Unified Schools of Artesia, California (3). Here the term Flexible School Year described a continuous learning program. At the Ferguson School in Artesia, classes were kept in session for 50 weeks a year, or 235 days. Students could adopt any schedule they desired provided they came for at least the 175 days mandated by state law. Students were also encouraged to attend as many days as they liked over and above the minimum. As long as students observed the mandate that they attend 175 days of school, the choice of time was theirs.

Combined with the introduction of flexible attendance requirements is an individualized elementary school curriculum and a deliberate attempt to enrich the curriculum so children will voluntarily remain in school during the Christmas, Easter or summer vacation. This has been educationally sound because it has resulted in higher reading and arithmetic achievement. For the first time, disadvantaged children who had normally made no more than seven months of academic progress per year were able to make 10, 11, and even 12 months growth in subjects like reading and arithmetic.

The Ferguson all-year school plan has increased in popularity and helped retain learning for disadvantaged children, but its success can be attributed to a factor other than the rescheduling of the calendar, that factor is extra learning time. The third, fourth, fifth and sixth grade students who attended school from 195 to 218 days achieved far better than comparable students did under a traditional school year calendar with only 175 instructional days.

Figure 8 shows a comparison of the number of third, fourth, fifth and sixth grade students who made more than a full year's growth in arithmetic and reading under two different length school calendars. It demonstrates that children who attend school for more than the traditional 175 days can make significant gains in the basic skills of arithmetic and reading (3).

Continuous Learning Calendar

The Continuous Learning Year Calendar calls for a rescheduling of vacations. Initially, there were several variations of the Continuous Learning Year Calendar that guaranteed all students a full four-week summer vacation, plus two or three one-week vacations interspersed throughout the year. Several variations of year-round school calendars, which can serve as models, are currently in operation. For example, the Parkwood School in Hayward, California has children attend school throughout the year based on a calendar which provides four ten-week learning periods interspersed with three one-week vacations. Valley View's 45-15 calendar, which has served as a model for over one hundred all-year school programs, provides a series of nine-week (45 day) learning periods interspersed by three-week (15 day) vacations.

Originally, Continuous Learning Year Calendars were designed to increase school plant capacity by overlapping three or more groups of students in attendance at any one time. Today, a small number of schools are operating within the framework of a single stream Continuous Learning Year Calendar because of its educational advantages.

Effectiveness in Compensatory Education. Evidence of the effectiveness of the year-round programs can be seen in the following summaries of research in which the Stanford University Research Institute with Federal financial support studied the learning effects of compensatory education (32).

The Pajaro Valley Unified School District in Watsonville, California offered a prime area for study. Three school buildings operated under the traditional calendar, while five operated under the 45/15 term rotation plan. Parents were allowed to send their children to schools operating under either plan. Children who attend five all-year schools were assigned to one of four groups, each group attending for 45 days followed by a 15-day vacation.

Reading. The result of the tests given to seventh grade students who completed a prescribed program of reading in Pajaro schools operating summer sessions as a part of a continuous learning year are shown in Figure 9. The anticipated summer slump does not exist. The Parajo seventh grade disadvantaged students appear to have been less than two years retarded in terms of their first fall test. The 5.6 G.E. (grade equivalent) mean shows they were reading on a fifth grade instructional

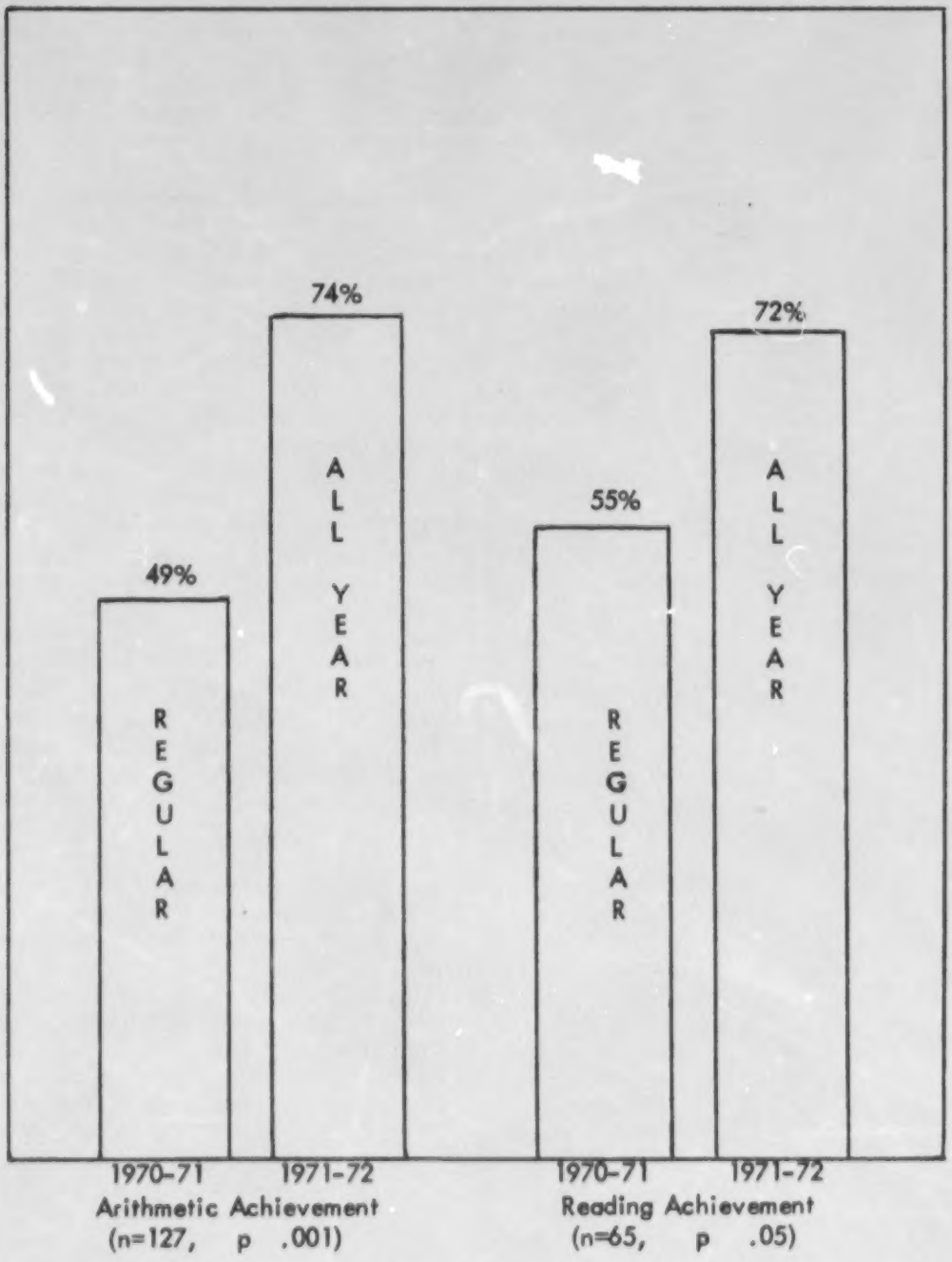

Figure 8. Percentage of Students Gaining 1.0 or More Years of Achievement in Arithmetic and Reading During the Regular and All-Year School Programs. (3)

level. The spring test mean of 6.7 represents an 11-month gain in reading or slightly better than a year's growth (1.1 G.E.'s) over a seven- to nine-month time interval which was interspaced by at least one three-week vacation. The learning curve continued to climb without a traditional summer dip. As a result, the second fall test shows a mean score of 7.2 grade equivalents. This represents a twelve-month gain of 1.6 reading grade equivalents. By the time students enter the eighth grade, they should be less than one year below grade equivalent in reading.

The 183 fifth grade disadvantaged students should have been reading at a high third grade level when they started the school year if they had been progressing at the .7 G.E. months per year rate as expected of other disadvantaged students. The progress of this group has been above the expected. The fall test median of 4.2 G.E.'s for the group was raised to 5.1 G.E.'s by the time the spring test was administered. The students made the equivalent of a year's growth in approximately seven school months. This was a good gain, but rate of progress was slower for the ensuing months. Figure 10 shows that there was no dip in the learning curve. The students continued to grow educationally. This is evident in the second fall test which shows that they had reached a 5.3 G.E. level. Having reached this level, the students should have started the sixth grade about ready for reading instruction on a high fourth or low fifth grade reading level. They had gained 1.1 school years from September to September. In contrast they would have gained no more than seven months had they been in a regular school year program in which their schooling had terminated prior to the start of a ten-week vacation.

Figure 11 depicts the reading progress of second grade pupils who had the advantage of what may be called a continuous learning program, including summer study. According to the first fall test scores the 174 second grade Pajaro pupils would have been ready to read on an instructional level at a first grade primer level. In actual practice they may have been started at a different instructional level since many primary teachers rely more on their own experience or their own test inventories to place pupils in the most appropriate teaching group than they do on standardized tests.

The California Test of Basic Skills was used for a measure of growth over a twelve-month period. It showed slow progress from Fall to Spring. For example, the fall grade median of 1.9 and the spring median of 2.3 G.E.'s indicated the students had made only four-months growth in seven months. In view of the experience encountered with other disadvantaged groups that had to terminate their formal instruction just when they were getting really started in their formal reading classes, one would have projected a loss of a portion of their four-months gain during the fall to spring months. In this situation the summer instruction prevented a loss of learning from occurring. Instead of a drop in the learning curve, Figure 11 shows that a continuation of reading growth took place between the spring test data and the following fall test data. The result is a final mean test score of 2.7 G.E.'s for a net gain of eight months in a twelve-month period that only provided 175 instructional days.

Two things occurred, namely a retention of learning and a continuation of learning to higher accomplishment levels.

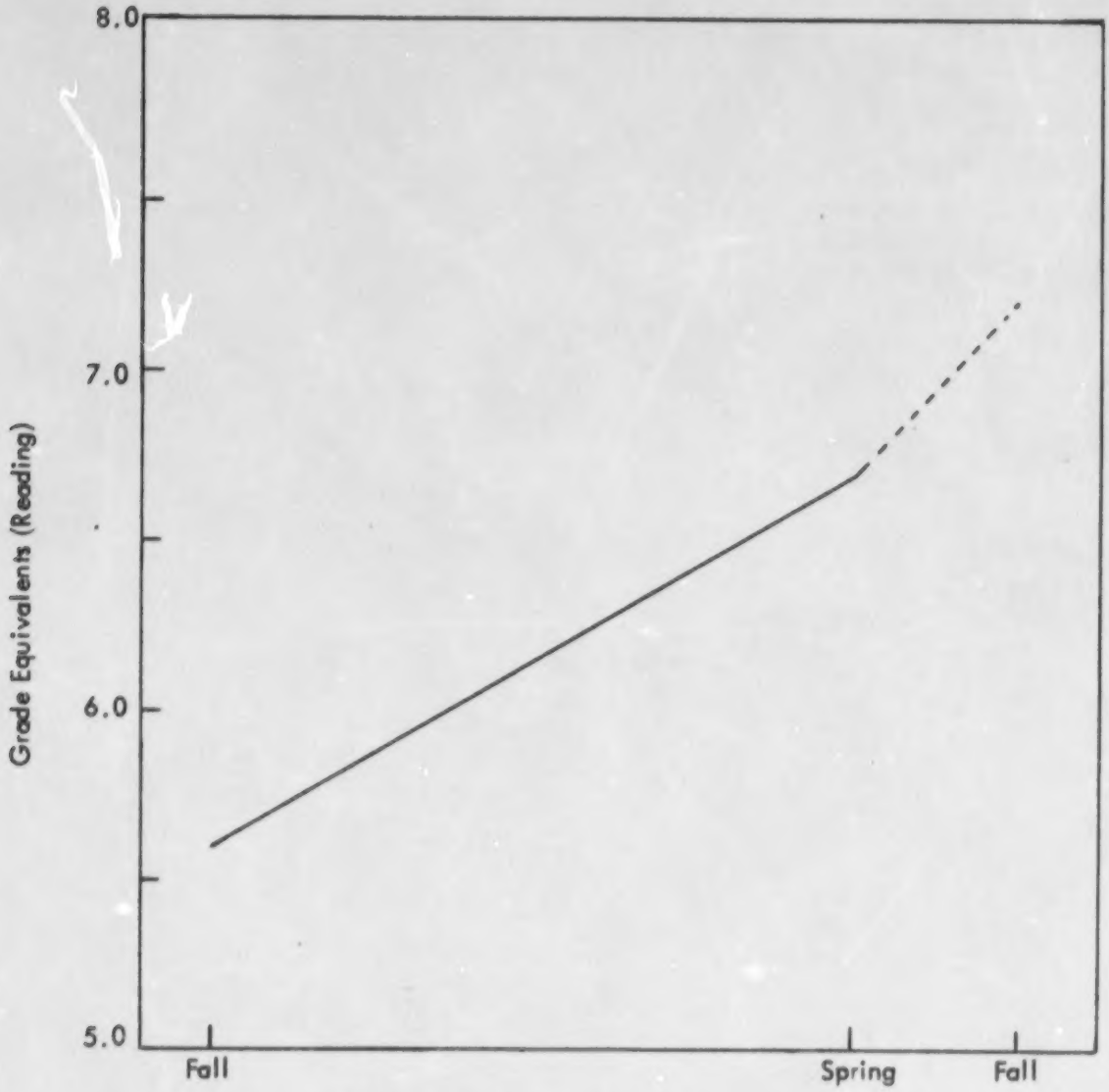

Figure 9. The Potential Advantage of a Continuous Learning Program: Results of California Tests of Basic Skills Administered to 7th Grade Disadvantaged Pupils in a Year-Round Program (31).

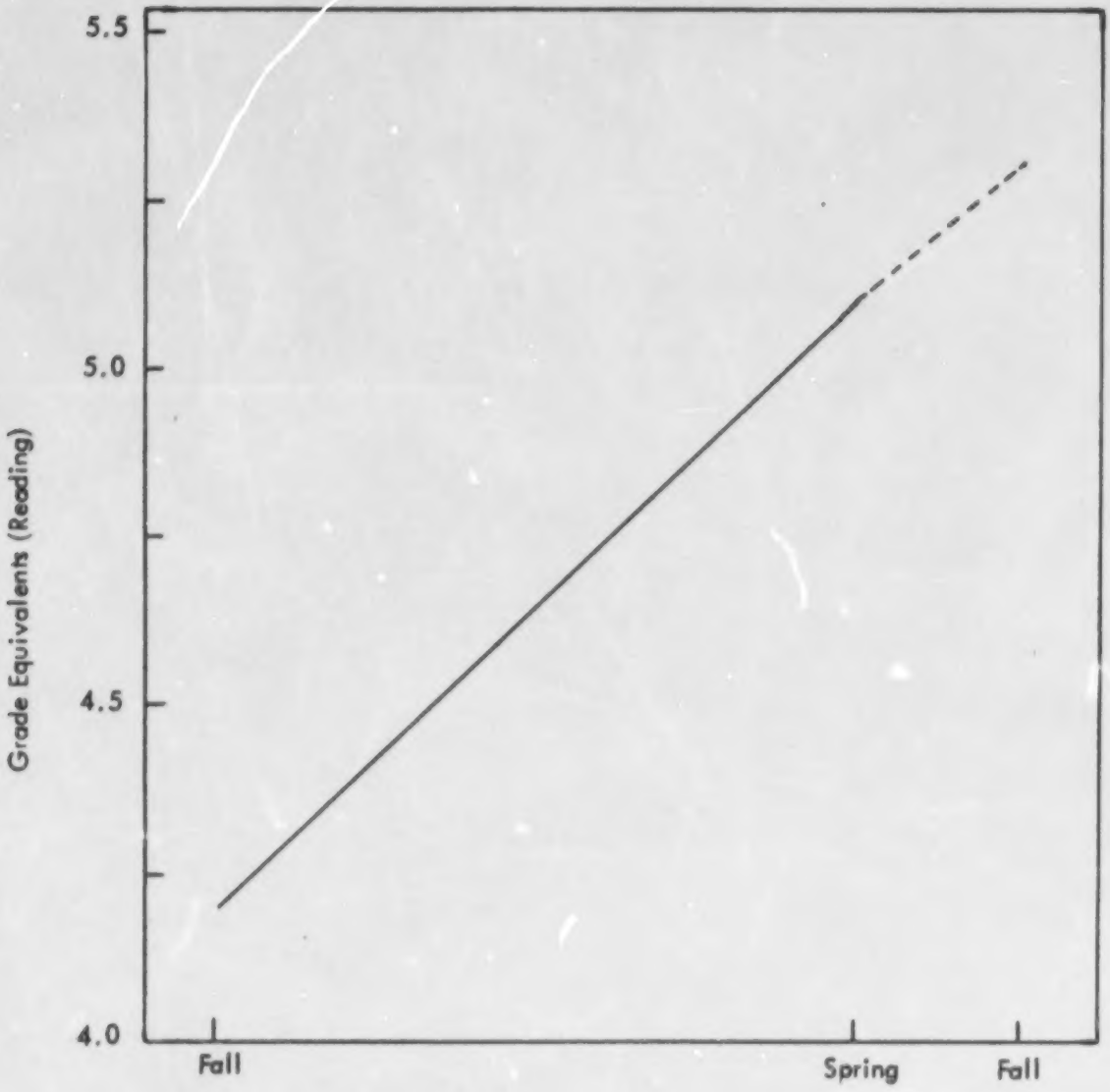

Figure 10. The Potential Advantage of a Continuous Learning Program: Results of California Tests of Basic Skills Administered to 5th Grade Disadvantaged Pupils in a Year-Round Program (31).

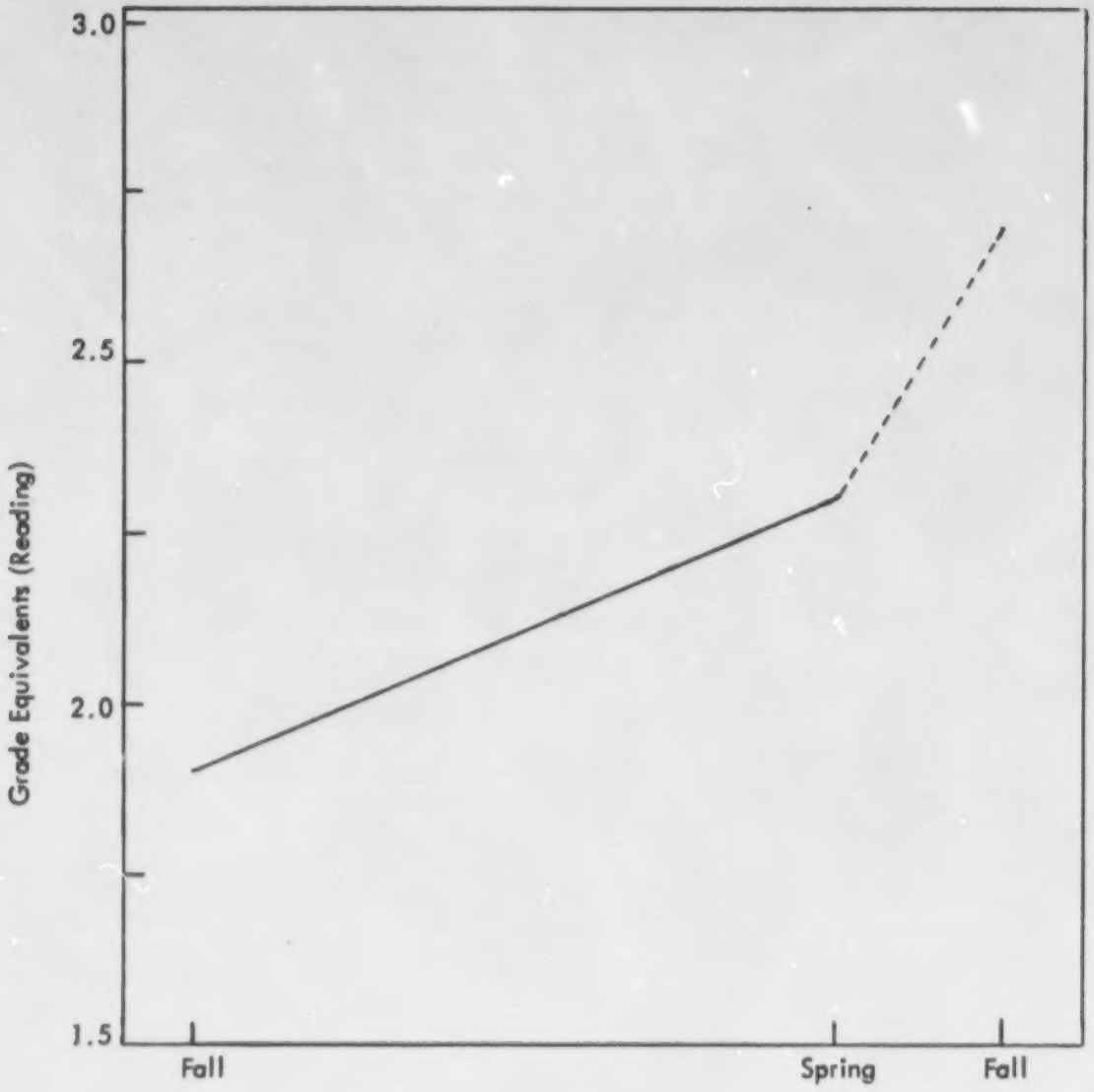

Figure 11. The Potential Advantage of a Continuous Learning Program: Results of California Tests of Basic Skills Administered to 2nd Grade Disadvantaged Pupils in a Year-Round Program (31).

Mathematics. Figure 12 shows the growth curves of three grades of Pajaro students who worked under the continuous learning year calendar. Here one sees that 154 seventh grade students had a mean grade equivalent score of 5.9 on the first fall test. On the spring test their mean score was 6.8 showing that they had gained nine grade equivalent months. Between the spring test and the second fall test point instead of turning downward, the curve continues to rise with only a slight decrease in rate. By the second fall test the seventh graders have reached an arithmetic mean of 7.1. Thus, from fall to fall they have gained twelve grade equivalent months or twice that of the students in the other California school. Apparently, the fact that the student calendar provided four vacations of approximately three weeks each did not lead to a loss in learning.

Figure 12 shows growth curves for second and fifth grade students. Here, again, the students show steady growth. While the arithmetic test means show that the students are still retarded academically, the fact remains that the fifth grader who started in the fall three years below grade did make eleven months gain from fall to fall. Similarly, the second grade students made nine months growth. Both of these gains exceed the expected growth of disadvantaged students.

Differences in Learning Based on School Calendars

Figures 13 and 14 demonstrate potential advantages of two educational calendars. Figure 13 depicts the learning curve of disadvantaged children attending California schools under a traditional or regular nine/ten month school year calendar. It shows their "in session" growth as they work in special Title I Compensatory Education Programs from a fall to spring term and on through to a second fall test point. The educational progress of these disadvantaged children during this time interval is better than may normally be expected of children characterized as average, at least from the fall through spring term. The noteworthy part of the learning curve is the part beginning with the spring test point and extending through to the second fall test point. This represents a decline or loss of learning when the students are enjoying a full 10-week summer vacation. It also depicts the type of loss in reading which often leads to condemnation of schools because so many children perform at low academic levels.

Figure 14 shows continuing growth when students have a summer vacation of only three to four weeks as a part of the continuous year curriculum.

Variations in Summer Study

In addition to rescheduling the summer vacation through implementing a 45-15 calendar, the Pajaro Valley School system extended the school year through operation of elementary and secondary summer schools. In 1977, some 1,650 elementary school children and 1,195 secondary school children completed a four-, six- or ten-week summer school program. The Department of Migrant Education implemented a morning and afternoon ten-week summer school program to meet the specialized needs of migrant children. An evening summer session took care of the needs of older students.

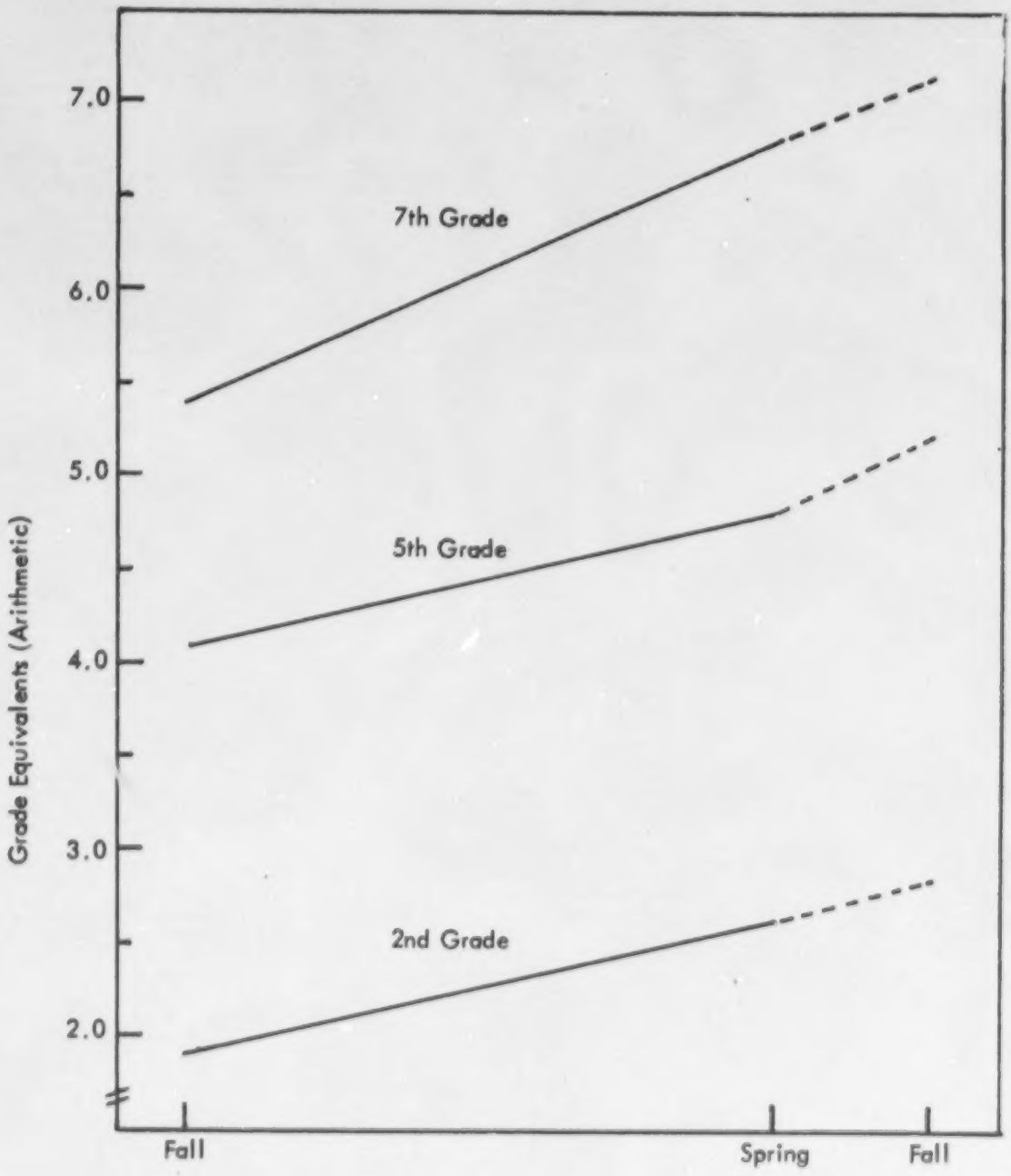

Figure 12. The Potential Advantage of a Continuous Learning Program: Results of California Tests of Basic Skills Administered to Disadvantaged Pupils in a Year-Round Program (31).

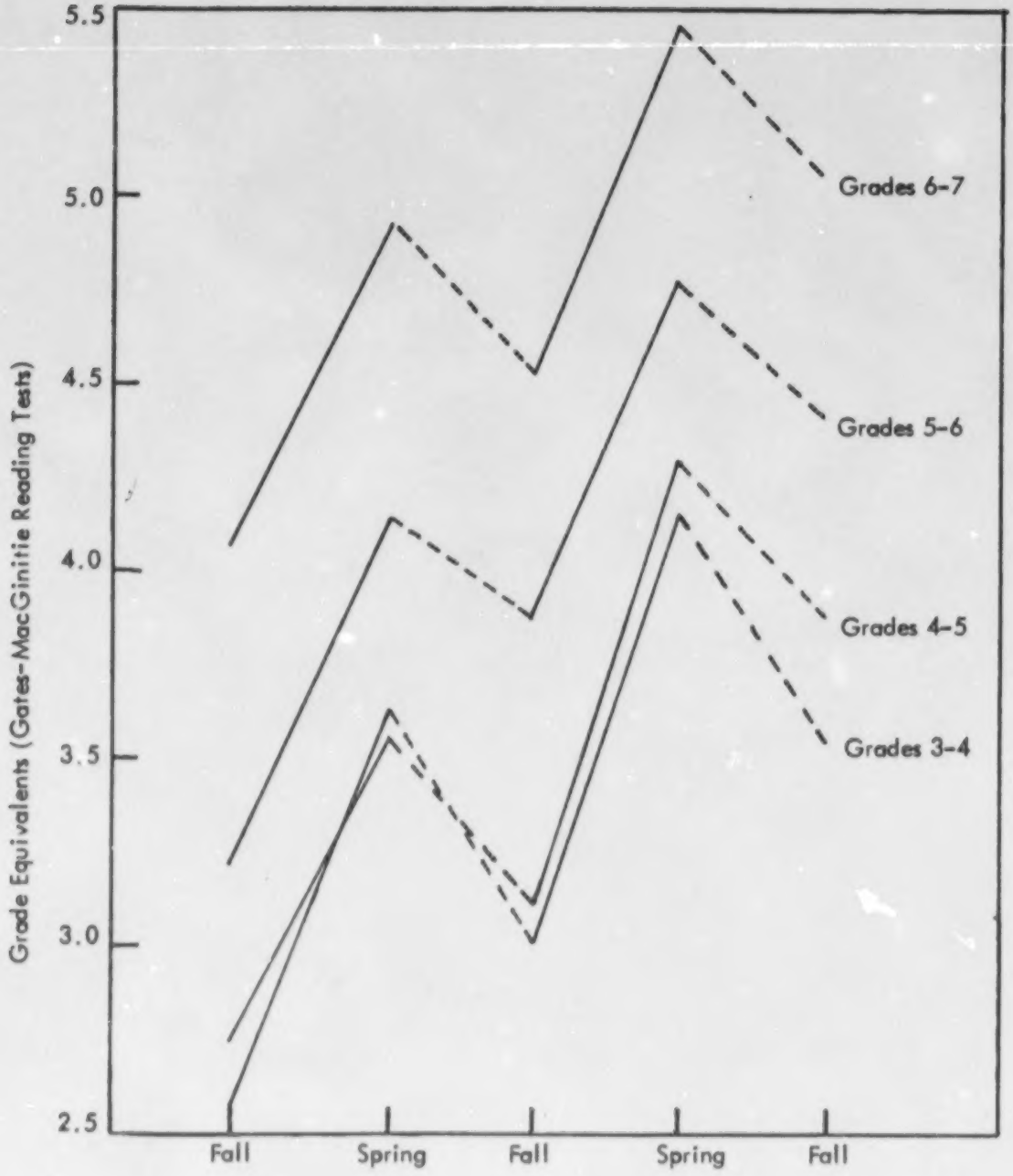

Figure 13. Learning Rates of Disadvantaged Children Attending California Schools under a Traditional School Calendar (33).

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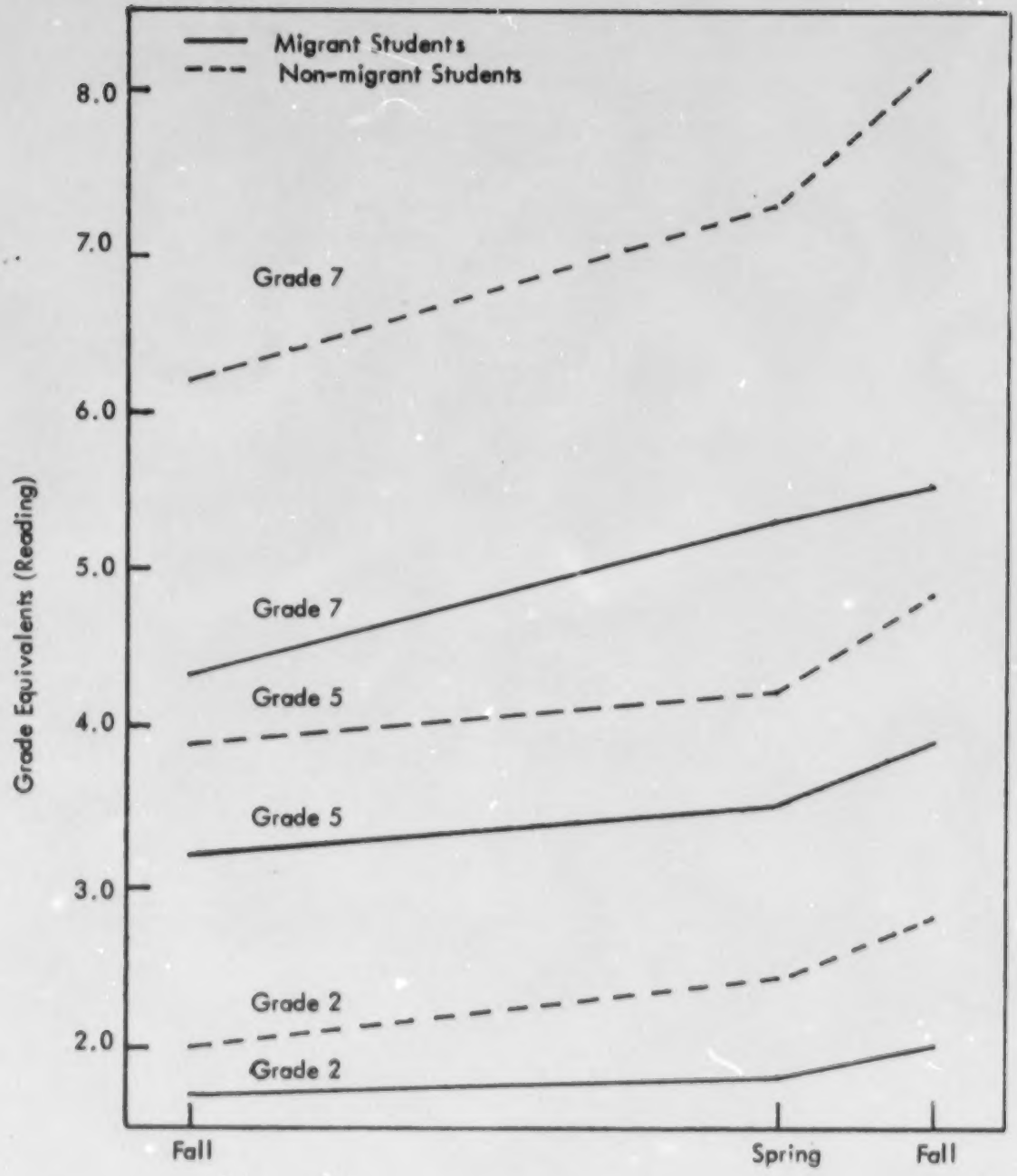

Figure 14. Learning Rates of Migrant and Nonmigrant Children Attending Schools Under a Continuous Learning Year Plan (31).

Some of the following illustrations show learning curves or achievement trend lines for second, fifth and seventh grade students who demonstrated that they could retain earlier skills through attending summer schools. Their progress is shown with that of comparable students who had the advantage of being involved in a school operating under a 45-15 plan calendar which provided 175 instructional days.

The Pajaro Valley School System has a number of types of disadvantaged children. Some of them come from migrant family homes. The migrant children may not be in a designated school very long. Therefore, their academic achievement is often low. Test data from the Pajaro Valley Study contains achievement from groups of migrant school children who attended special summer school classes established for them as well as for migrant children who attend 45-15 all-year schools.

Figure 15 shows the reading achievement of second, fifth and seventh grade migrant children under both types of school calendars. In both cases the slope of the learning curve rises during the critical summer months.

Figure 16 shows arithmetic growth for the same groups of children. In this illustration the seventh grade students who attended school under a regular school year calendar plus a summer program failed to maintain their earlier gains. This is evident in the way the learning curve dips after the spring test point. In contrast the continuous learning year (45-15) calendar seventh graders continued to gain over the summer months.

Figure 17 shows the comparative reading achievement of nonmigrant worker children who attended the regular school year program with a ten-week summer school and nonmigrant worker disadvantaged children who attended the all-year school. All of the pupils show a continuous growth over the full twelve-month period. While the second grade students did not make a full year's growth, they did make slightly more than the seven-month's growth frequently made by disadvantaged students not exposed to a Title I compensatory program. All other students made at least a full year's growth. The seventh grade group in the all-year school program made 19 months growth or almost two years progress in twelve months.

This may be compared with the reading learning curves of non-migrant students of Figure 14. Here one can see the apparent impact of continuity of learning with no ten week summer school to cloud the issue. In each case, all continuous year students showed gains beyond the spring test point.

Both the year-round or continuous learning year calendar and the addition of summer school reverse the downward trend in achievement of disadvantaged students over the summer months. The continuous learning year concept need not add more days or hours of pupil teacher contact, while summer school does. Both concepts shorten the time between learning periods, apparently increasing retention and reducing forgetting.

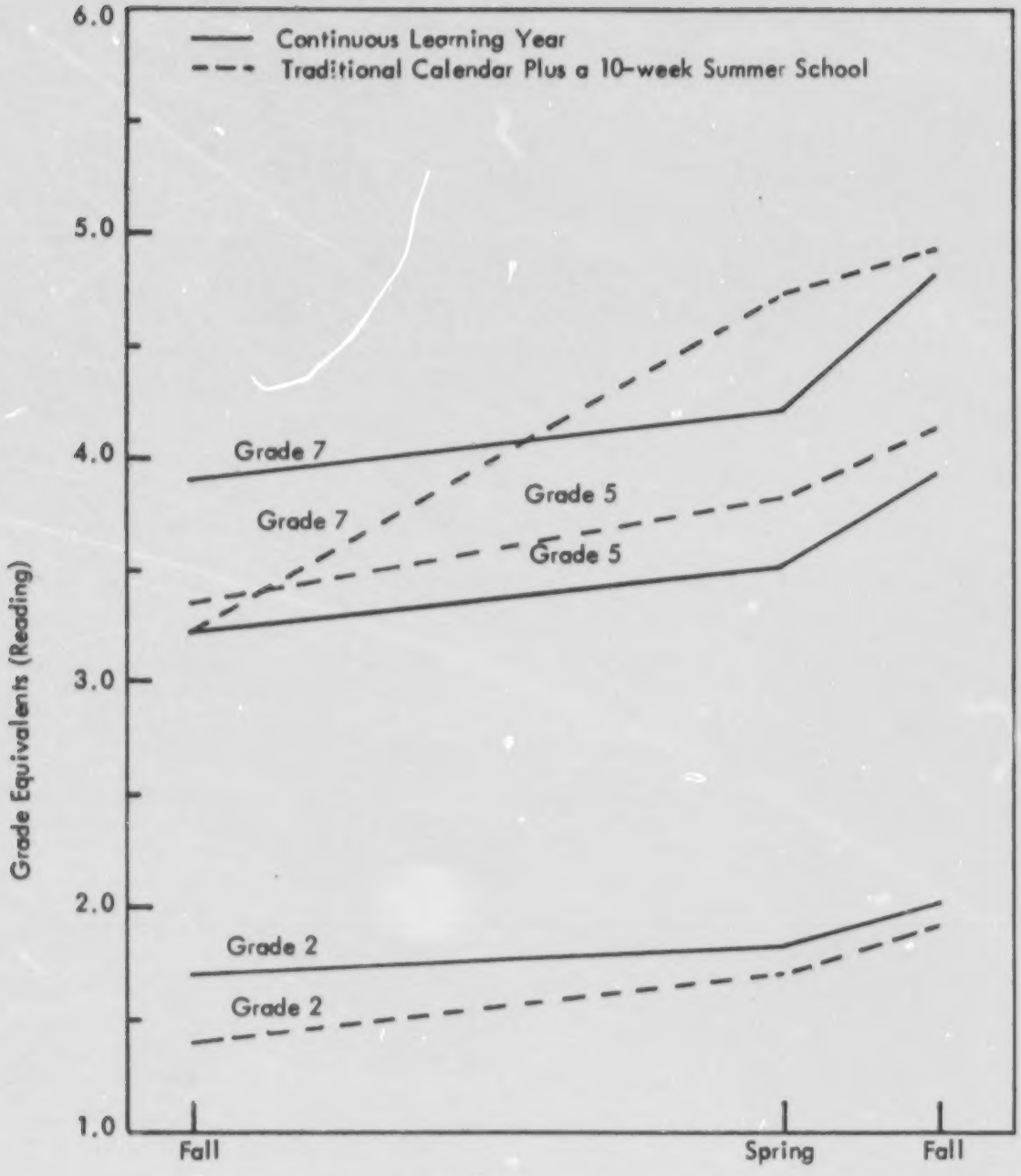

Figure 15. Reading Achievement of Migrant Children Attending School Under Two Different Types of Continuous Learning Year Plans (31).

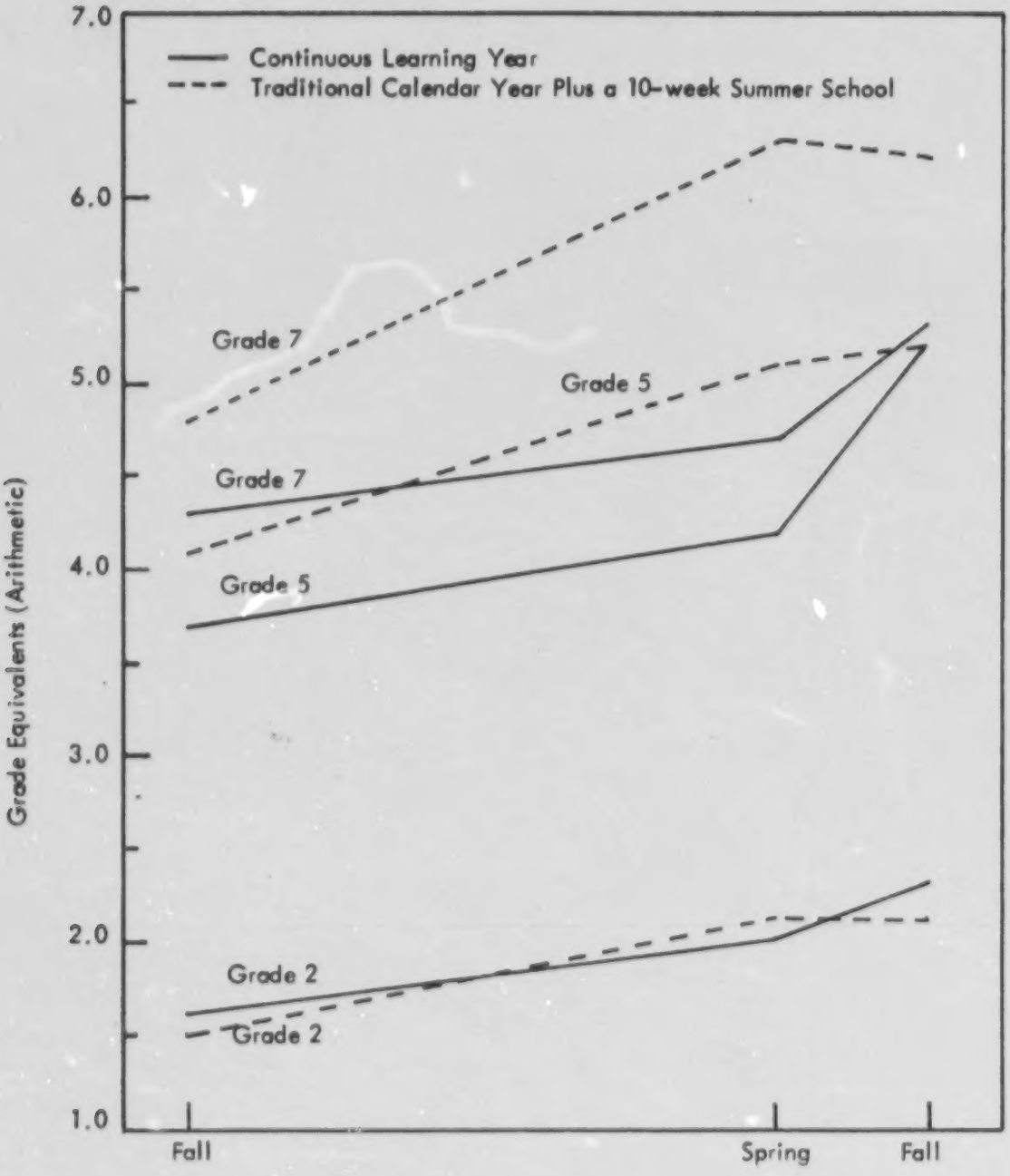

Figure 16. Arithmetic Achievement of Migrant Children Attending School Under Two Different Types of Continuous Learning Year Plans (31).

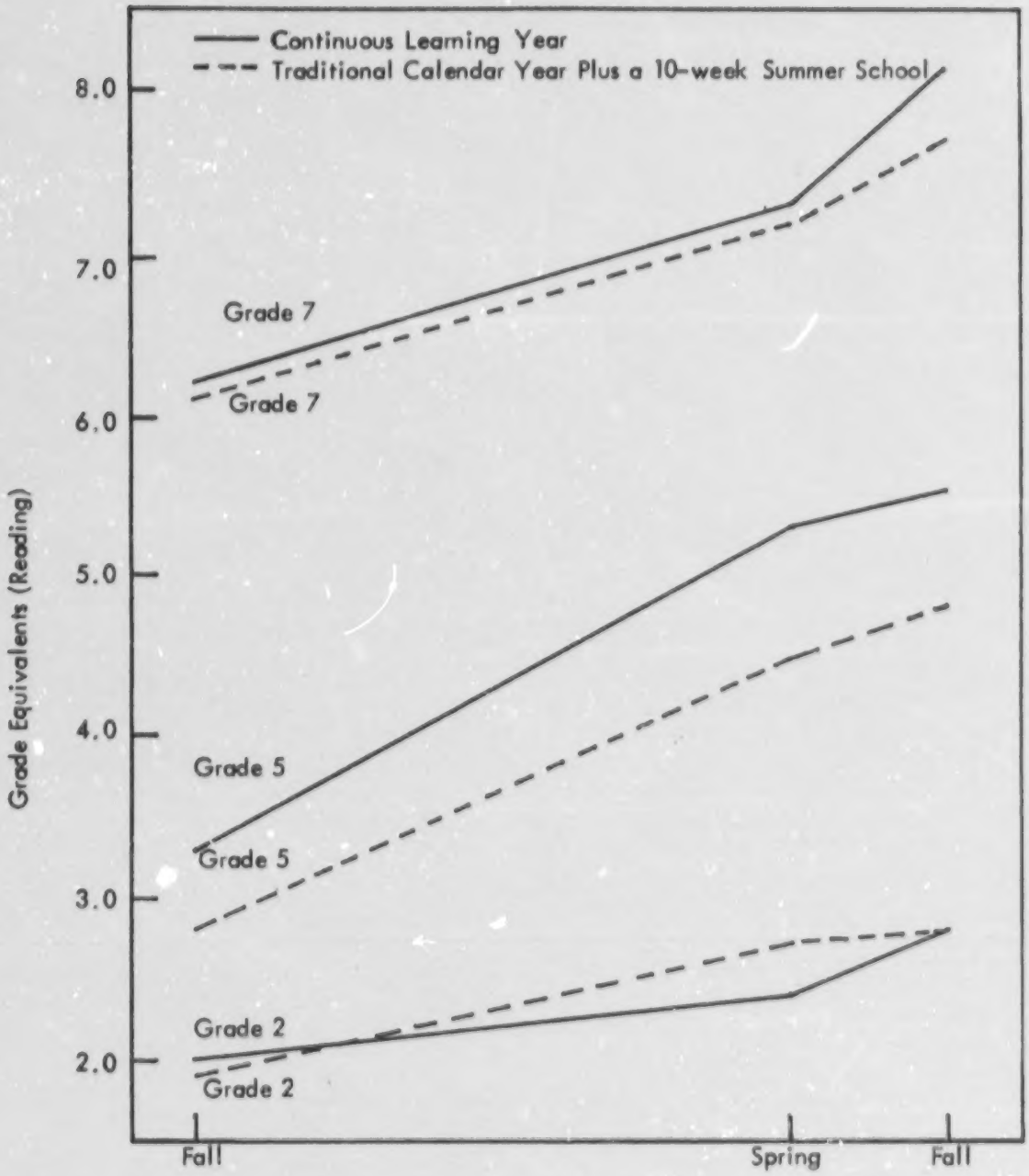

Figure 17. Reading Achievement of Nonmigrant Children Attending School Under Two Different Types of Continuous Learning Year Plan (31).

Chapter 8

THE ROAD AHEAD

The problem of retaining school-engendered learning cannot be separated from teaching and learning. One phase of this study has been concerned with the preservation or maintenance of skills and knowledge during the in-session days, weeks and months. It has been shown that in order to retain once-achieved levels of knowledge, teachers have no choice but to review, reteach, provide experiences in which prior knowledge and skills are reused, or offer a crash review or cramming period prior to the final examination. The quality of the teaching during the in-session months has been considered as an important factor in determining the amount of forgetting which occurs over the summer. However, for approximately 40 percent of the students, the time element has created barriers to the preservation of learning regardless of the ability of the teacher to impart skill and knowledge to each student. It has been implied in this report that a provision of extra instructional time during the school year and during the summer months will enable educationally disadvantaged students to narrow the gap in learning between themselves and their more advantaged cohorts. Unfortunately, the special compensatory type programs which have led to these increases in learning require some special day-by-day adjustments in individual student programs. For example, one cannot provide disadvantaged pupils with five extra hours of instruction in basics without borrowing time from some other subjects. This raises the question of a balance in these students' total educational experience.

The School Year

Unfortunately, the gap between advantaged and disadvantaged children is never going to be closed, even through a rescheduling of the school calendar, unless the equivalent of the compensatory education programs becomes a part of the daily program. This means that disadvantaged children will require a flexible school day or flexible weekly schedule.

One solution to program inequalities calls for a school day of different length class periods or hours. A second solution may be found in the use of mini-courses or special help programs. Currently many school programs provide special activities during vacations or on weekends. However, the special programs are currently a part of the freedom of choice plan. Compensatory programs may be deemed essential to serve as a leveling agent for disadvantaged children.

One recommendation, which can lead to the preservation of learning, calls for more frequent use of knowledge skills over extended periods of time. When this is not a normal and ongoing process, it may be necessary to set up periodical evaluations or tests to see if knowledge and skills are being retained. Failure to maintain the prior learnings should call for retraining, review or reteaching.

A number of Continuous Learning Year calendars could be structured for schools whose students fall in the disadvantaged category. The calendars could provide for common regional vacations. They should provide at least 180-186 instructional days, thereby allowing sufficient days for emergency closings. Since most schools lack air conditioning, it is recommended that the summer learning period be restructured in such a way that all children are released from classes by mid-day. This can be done so there is no actual difference in the number of instructional days provided in the new continuous learning year calendar than provided in the regular school year calendar. For example, principles of time equalization can be adopted where comparable instructional hours are mandated by law.

The Electronic Age

Learning is an individual matter. The conventional school program began with a lockstep approach. A whole class was taught the same material and skills on the same schedule. Those who did not keep up, dropped back and then out. Later, sections and platoons were established permitting sub-groups of students (the average, the slow-learners, the gifted) to move along at variable rates. But, if a program were adopted for each individual child, optimum learning could occur. The main drawback to such a system is that it would be very expensive in terms of personnel costs.

However, the New York State Education Department has sponsored a decade of implementation and application of a prototype instructional management system. It virtually individualizes instruction through creating a mix of student-teacher-materials. For example, its new components are:

1. Collections of objectives and test items for mathematics, reading, science and social studies;

2. Training manuals;

3. Comprehensive achievement monitoring which generates computer based-data from criterion-referenced tests.

Put more simply, students take initial tests before exposure to a curriculum or curricular unit. Each student then is excused from working on skills or concepts he already knows. When he has filled in missing gaps through study he takes a final test. If he is weak on some items, he goes back over them until he has mastered the whole unit. Ideally, the pupil test and item analysis is known as instantaneously as the bill at a supermarket checkout. Too, study and review materials are located as readily as a book in the library.

With the rapid growth of closed circuit television, individualized learning packages can be used in homes, neighborhood learning centers and schools. The development of coaxial cables or phones will facilitate such a system.

Present technology can allow better learning and retention through:

1. Year-round, lifelong learning systems;

2. An optimal mix of personnel and machines through an individualized instructional management system;

3. Classification of knowledge and skills in a new look at curriculum;

4. Cohesive development of social, economic and educational resources.

Educational and psychological researchers are discovering ways by which an ever expanding body of knowledge can be learned and retained, and forgetting reduced. Changes in such an important area as the education of our children must proceed cautiously. Certainly, changes can not be made without the full agreement of parents, and society as a whole. Yet, some changes can be made within the present school operational procedures. Review and emphasis upon concepts, where not a part of the teaching process, can be added. Too, enrichment and catch-up opportunities can be offered during the summer time. Learning and retention of knowledge can be increased, especially that of lower socioeconomic children, thereby helping each child to reach his or her potential.

Appendix A

A Summary of Representative Forgetting and Retention Studies

A. Elementary Level

Subject	Pertinent Findings	Research & Year
General	A four-year study of primary grade achievement showed a summer loss of 0.31 of a school year on Gates Primary Reading Test and 0.41 of a year on the Metropolitan Achievement Test. Many children returning to Grades II and III in the fall had failed to retain a satisfactory amount of skill in writing and in the use of numbers.	Cook, Ruth C. 1942
General	The evidence of a substantial loss during the summer months in the arithmetic and language tests administered to students in grades 5 and 6 is consistent and convincing.	Beggs, Donald L. Hieronymous, Albert N. 1969
General	The difference in the rate of growth in achievement between poor children and those who are not classified as poor is greater during the summer months than during the school year.	David, Jane L. 1977
Kindergarten	There was poor reading readiness skill retention on the part of kindergarten children over the summer, especially by those who had scored low on a spring readiness test.	Keister, B.V. 1941
Kindergarten	The study showed that with the exception of the initial consonant test, there was a significant increase in the mean test scores between May and September. Visual discrimination skills were more successfully retained than auditory skills.	Rude, R.T. Niquette, S. Foxgrover, P. 1975
Reading First Grade	All first grade students showed a decline in reading proficiency over the summer.	Brueckner, L. J. Distad, H.W. 1924
Reading First Grade	It is possible for children who enter Grade I before they reach the age of six to make normal progress in reading during the first year. The skills attained by such under age children lack permanence and tend to disappear during the summer months between Grades I-II.	Keister, B.V. 1941

Subject	Pertinent Findings	Researcher & Year
Reading (6 to 8 years old)	On the 27 measures of word attack skills employed there were no significant differences between spring and fall test scores on 15 measures. On the remaining 12, both significant losses and gains were evidenced. Subjects scored significantly lower in the fall than in the spring on 7 measures, all of which were phonetic skills. The 5 significant gains occurred on structural analysis skills.	Rude, .T. Otto, W. Klumb, R.W. 1973
Reading	The summer vacation had little effect upon the reading ability of average and above average students in grades 4 to 8. The median scores which were used to draw the conclusions that there was no loss hid the reading losses on the part of below average or slow progressing students.	Patterson Mildred, V.W. 1925
Reading	Study showed that 70% of the students improved in reading ability over the summer while 30% performed at a lower rate in the fall than they had in the spring.	Momson, J. 1947
Reading	A study involving some 380,000 New York City students showed that low socioeconomic students lost as much as one to two months during the summer. Other students continued to make modest gains, especially after fourth grade.	Heyes, D.P. King, J.P. 1974
Reading	A study of reading in grades 2-7 in San Jose, California showed little or no reading achievement loss over the summer even though the reading rate of gain was substantially less than that for the regular school year.	Thomas, M.A. 1976
Arithmetic	The summer was detrimental to the arithmetic achievement of all students.	Patterson Mildred, V.W. 1927
Arithmetic	Two year study of 150 fifth grade students showed summer loss on Woody McCall Arithmetic Test between spring and fall test approximated four months.	Dix, William L. 1929
Arithmetic	There was a general decrease in arithmetic accuracy during the summer vacation and arithmetic loss equivalent to almost two years for all of the students tested. Seventh grade students reportedly had the greatest loss.	Garfinckle, M.A. 1930

Subject	Pertinent Findings	Researcher & Year
Arithmetic	Over an interval of 9 weeks, the ultimate tasks are not forgotten, whereas the subordinate arithmetic tasks learned prior to the ultimate tasks showed substantial forgetting had occurred.	Gagne, M. Brassler, O.C. 1963
Reading and Arithmetic	Study cites nine investigations of changes in standard test performances for children in grades III-VIII: three reported improvement in reading, four noted little change and two noted serious loss.	Keys Noel Lawson, J.V. 1937
Reading and Arithmetic	Study shows losses occur in arithmetic problem solving and in spelling over the summer.	Heyns, B. 1977

B. Secondary Level

Subject	Pertinent Findings	Researcher & Year
Algebra	Students lost 67% of the original material during a period of one year following completion of a course in algebra. Girls retained more than the boys.	Layton, E.T. 1972
Arithmetic	Eighth graders lost 4 1/2 months of their arithmetic computation skills over the summer. Ninth graders lost 7 months of their arithmetic skills over the summer. More mature 8th grade students forgot less than those who were not as mature except in paragraph meaning, word meaning, literature and arithmetic computations.	Schrepel, M. and Laslett, H.R. 1936
Chemistry	There was a 50% loss in 6 months. The greatest loss was of a technical nature such as chemical equations and the solution of chemical problems.	Powers, S.R. 1921
Chemistry	Retests given at the end of three months showed a retention of 58% or a loss of 42% of the course content.	Powers, W.H.
Chemistry	A retest given a year after the completion of the course showed 84% of the initial gain was retained in the area of general information, 92% in the application of facts and principles, 66% in knowledge of chemical terms and 70% for symbols and formulas.	Mursell, J.R. 1932
Chemistry	Study showed that retention was poor when students took the subject only because it was a requirement.	Smeltz, J.R. 1956
English	Only 7% of the high school seniors could write or use better English than the students in the freshman class although they had taken English during each of the preceding school years.	Mursell, J.L. 1932
French	Study showed an overall loss in French of 31% at the end of 11 months but subtests showed 70% loss for principal parts or irregular verbs, 59% principal parts, idioms 66%, English into French 53%, for French into English 7%.	Powers, S.R. 1921

Subject	Pertinent Findings	Researcher & Year
French (a second language)	Study #1 measured the effect of a summer vacation on retention. It showed the first semester students had a gain of approximately 3% in listening comprehension and 5% loss in French reading comprehension. Study #2 measured the effect of time lapse of one semester (June to February) during which time the students studied other subjects but did not study French. The post-test showed a 4% loss.	Smyth, P.C., Jutras, J.C., and others 1973
Literature	Retention tests administered thirty days after pretest showed a 60% loss for poetry and a 70% loss for prose.	Guilford 1952
Mathematics	Students showed a loss of 10% in computational ability over the summer vacation plus an additional 19% during the fall semester. Further testing showed a noticable increase in the amount of loss at the end of eight- and twelve-month periods.	Sister Lahey 1941
Typing	The summer vacation had very little effect upon the speed of typewriting. Similarly the summer vacation had no marked effect on the accuracy of typing.	Schroeder, Lowell J. 1934
Typing	Students who completed first year of typing required 10 hours of renewed practice in September to regain June speed. The same practice time was required after the second summer vacation.	Ammons, R.B. et. al. 1958
General	Level of retention is retained longer when the content is interesting. Study shows a 15 to 20 percent loss in 3 days. After test there was a stabilization of retention. There was a 30% loss at the end of 30 days.	Gilliland 1948

Appendix B

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